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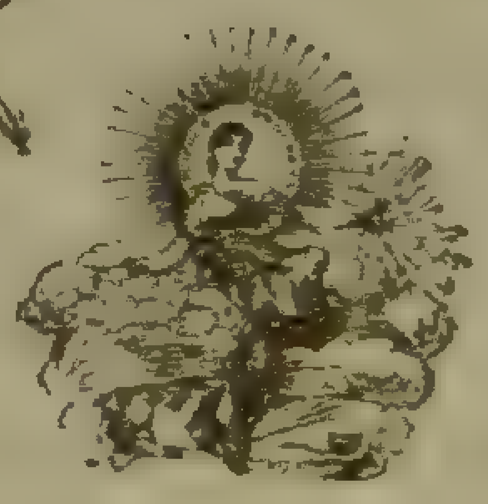

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CRITICISM OF SOME CASES OF APPARENT TRANSMISSION OF MUTILATIONS.[1]

TRANSLATED FROM THE GERMAN OF DR. O. VOM RATH.

Whenever a discussion arises as to whether characters acquired in the life of the individual are transmitted, first of all is ordinarily put the special question[2] whether the transmission of mutilations may be admitted. In various papers Weismann (32) has shown that the previously known cases of alleged transmission of mutilations do not hold their ground before careful criticism, and are far from serving as indisputable proof. In the judgment of such cases so much greater care is necessary, since it is often very difficult to decide

[1] TRANSLATOR'S NOTE.—This article appeared originally in the Berichte der Naturforschenden Gesellschaft zu Freiburg, i. Bn., Bd. VI, Heft 3, and was reprinted in the Biologisches Centralblatt, Bd. XIII, No. 3, p. 65–76, from which it was translated. Especially in its striking proof of the necessity of extreme care in sifting and testing evidence, it forms a most valuable contribution to the literature of a subject which, perhaps, more than most others, has been marked by failure to apply sharply the scientific method.—*Henry B. Ward, University of Nebraska, Lincoln.*

[2] The special question of the transmission of mutilations is of the greatest importance, since a single case of such transmission, if entirely beyond question, would be sufficient to decide finally *the entire matter of the inheritance of acquired characters*, since, in that case, the possibility of the transmission of all characters acquired in the lifetime of the individual, in physical as well as intellectual relations, would also have to be granted. By the by, I should like to mention just here, that at present some authors, and with them a part of the educated laity, are inclined to deny the transmission of single injuries or mutilations, but, on the other hand, to look upon the transmission of acquired characters upon the whole as possible.

whether the abnormality present in the paternal or maternal individual was actually caused by some external interference, or arose as an inborn (blastogenic) variation of the germ. Of those authors who deny the transmission of acquired characters, the pathologist, E. Ziegler (35), approaches most closely to the Weismannian point of view, and his valuable papers in which he discusses the most recent articles on inheritance and the doctrine of descent and their importance for pathology, form important supplements to the writings of Weismann. Among other things, E. Ziegler emphasizes the fact "that pathological characters acquired in the life of the individual are not transmitted, and that the first origin of transmissable diseases and mutilations is not to be sought in the acquirement of corresponding changes during the life of one of the parents, but in variations of the germ."

It is by no means my intention to go into the extensive literature on this point.[3] The purpose of my article is rather to communicate some interesting cases of apparent transmission of mutilations, which I learned of by personal experience, and was able to test carefully. If even now some of these cases do not permit a definite decision, still it may not be useless to recount them here, since, by just such examples which, at first glance, let no doubt of the fact of such transmission appear, it can best be shown with what extreme care an unpartisan observer must prove the true character of the case, and pass judgment upon it.

Before beginning my description, let me call attention to the fact that the expression "acquired character" has been used by different authors often in a very different sense. Weismann has expressed himself on this point as follows: "Since the term *acquired character* is not taken by all the in sharply circumscribed sense in which it is used by zoologists and botanists, I propose, in cases where a misunderstanding is possible, to use,

[3] I refer especially to the important papers in the appended list, those of Weismann (32), Ziegler (35), Eimer (9), Kölliker (16), Virchow (28), Claus (5) and others. In passing, I should like to call to mind the fact that two years ago the question of the inheritance of acquired characters was discussed clearly and pregnantly by van Bemmelen (1), in a historical critical investigation, with reference to the standpoint taken by Weismann, and with a review of the most important literature.

instead of *acquired*, the word *somatogenic*, i. e., proceeding from the body—*soma*—in contrast to the germ substance, and to designate such characters as proceed from the composition of the germ as blastogenic. If a man's finger is cut off, his tetradactyl condition is a somatogenic or acquired character; if, on the other hand, a child is born with six fingers, this condition must have proceeded from the peculiar constitution of the germ substance.[4] It is therefore a blastogenic character." In this description I shall adhere to Weismann's form of expression.

The facts of the first case are as follows: In a family closely related to myself was kept a pair of dogs (terriers), faultless in every particular; both dog and slut were known to have had fully normal parents, and on their part to have produced, in several litters, normal young. By an unfortunate fall, the dog suffered a break in the upper part of the right humerus, as a result of which, even to-day, there remains a peculiar posture of the damaged extremity, connected with continued limping. In the next litter, which followed some time after the complete recovery of the father, were three young, two dogs and a slut. The fully normal young slut died soon after birth. Shortly thereafter, the mother came to her end also. Of the two young

[4] The question whether such a sharp fundamental difference as Weismann emphasizes can be made between germ and body cells, so that every trace of germ plasm is wanting in the somatic cells, has been answered in varying manner by different authors, and, for example, is distinctly denied by Kölliker (16). That moreover, among the lower plants the difference between somatic and propagating cells may be very small, has been pointed out by Weismann himself (Biol. Centr. X, No. 1–2). "DeVries (29), the noted botanist, has pointed out that certain constituents of the cell-body, e. g., the chromatophores of the algæ are transmitted directly from the egg-cell of the mother to the daughter organism, while the male germ-cells ordinarily contain no chromatophores. Here then, the inheritance of somatogenic variations would be, it seems, possible. Yet, just in the lower plants, the difference between somatic and propogating cells is still slight, and the body of the egg-cell does not need to undergo a complete transformation in chemical and structural respects when it develops into the body of the somatic cells of the daughter individual. But what has that to do with the problem whether, for instance, the pianist can transmit to his descendants the strength of digital muscles acquired by practice. How does this result of his practice reach the germ-cells? Therein lies the riddle which they have to solve who maintain the transmission of somatogenic charaacters." For our purpose, however, this special question comes less into consideration since one may regard the question of the transmission of acquired characters for the present, as a purely empirical one.

dogs, the one was in every respect normally formed, and in color and form the true likeness of the mother, whereas the other dog not only resembled exactly the father, but also like him possessed an abnormally placed right fore leg, and continually limped with this leg from birth up to to-day, when the animal has long since reached full growth. At the sight of the dog, all eye-witnesses were completely convinced of the fact of the transmission of a former injury.

As will be easily understood, my attention was at once directed to establishing whether the peculiarities in question really corresponded exactly in father and son. To begin with, I found that after the fall, the right fore-leg of the father was essentially different from the left, and had remained so constantly, and that the animal continually limped on this leg, and always in the same way. A certain weakness and great tenderness is noticeable even to-day in the entire shoulder region, and especially at the spot at which the injury took place; the entire musculature on the humerus is also strikingly degenerate. The position of the injured leg (especially from elbow joint down) differs in a curious way from that of the uninjured left leg. The entire extremity has a fully crippled appearance. The apparently shortened forearm and foot of the right foreleg assume unmistakably a bow-legged position, and the entire extremity is strikingly bent inward.

The investigation of the limping young dog showed the following: In spite of careful feeling I could find on the right foreleg neither a sensitive place nor an abnormity of humerus or of the musculature; on the contrary, the right foreleg is externally completely similar to the left, but unquestionably different in posture and shape from the latter. While now in the father the right leg is "O"-shaped (bow-legged), and the foot is turned inward, the corresponding leg of the young dog shows exactly the reverse tendency in posture. It is rather "X"-shaped ("knock-kneed") and the foot is turned outward, but by no means so much as the corresponding foot of the father turns inward. The difference in the posture of the leg does not strike one so much when the two young dogs are observed together as when the father and the limping one are

compared along side of each other. In the usually very active movement of the animals, moreover, the difference in the posture of the legs does not become so evident as when the animals move slowly or stand still.

In judging this case it is to be noted, first of all, that the abnormality of the young dog which might be regarded as inherited (transmitted), does not agree in many particulars, especially in regard to the posture of the leg, with the acquired deformity of the father. There is, as it appears to me, a double interpretation of the case possible. Either one may assume that the abnormality of the young dog has appeared without any inheritance as a germ variation, which is not further traceable to its causes, and that a case of transmission has only apparently arisen, since by chance the paternal animal showed an acquired abnormality of the same leg as that on which, in the young animal, an abnormality arose by variation; or, on the other hand, one may regard the acquired abnormality of the paternal animal as the cause of the congenital abnormality of the young dog; in the latter event, it must be carefully noticed that the inherited peculiarity is very little similar to the original. Hence, there would be present only a certain influence, but not such a transmission as we perceived in the case of individual variations (blastogenic changes) in which the transmitted peculiarity differs, perhaps, in degree from the transmitting, but is always like it.

As far as the limping of the two dogs is concerned, I do not think that further significance can be attributed to this circumstance. To be sure, both dogs limp on the same leg—the father always alike, the son sometimes more and sometimes less, and often scarcely noticeably; thereby is by no means proved that the same cause lies at the bottom of the limping of both animals. As is well-known, quadrupeds, and especially dogs and horses, limp in consequence of the most varied causes, and it is often very difficult to find the real ground of the linping. In the case described, the limp of the father is evidently the result of the fall. I was as little successful as other investigators in finding the true reason of the trouble in the son, since nowhere on the entire body was a tender spot to be discovered.

The following case is so simple and characteristic, that no doubt can exist as to its interpretation. A Mr. S., a perfectly normal and well-proportioned man, had from youth up, the habit of turning the tip of his right foot outward more than that of the left, a circumstance which was especially apparent in dancing, and also showed prominently in foot-prints left in the snow or on moist ground. This peculiarity all his children (three sons) have inherited, only with the difference that in one of them, besides the right, the left foot also is turned out in a like striking manner. Since now the father of Mr. S., as a young man, acquired, in consequence of an apoplectic fit, apparent lameness of the right leg, as a result of which this leg was dragged behind, with the foot strikingly turned outward, one concluded that the peculiarity of the out-turned foot inherited from the older Mr. S. (i. e., a somatogenic character) had been transmitted to his son, and in still stronger measure to his grandchildren. As I stand in close connection with the family concerned, it was easy for me to acquire the necessary information, and I was able to establish the fact that the younger Mr. S. was already several years old when his father suffered the stroke, and further, that the elder Mr. S., from youth up, had complained of a certain weakness in the right leg, and that an important deterioration in the condition of the entire leg appeared directly after the stroke. If now one wishes to bring the out-turned foot of the younger Mr. S. in connection with the infirmity of his father, a thing which, according to my view, is not at all necessary, then it can be regarded as an inherited peculiarity in both the father and the son, i. e., a blastogenic, but by no means a somatogenic character. Such habits of peculiar postures of the foot not infrequently appear suddenly and without visible cause in some person or other, without a similar case having been known in the family of the same person. I also know a man who, from youth up, had the habit of continually turning the right foot in a striking manner inward, so that it was jocosely said of him he had two left feet; but neither in parents, brothers, children, nor other relatives of the man, has ever been noticed any special inclination to a striking position of the foot.

The third case which I shall now report came to my knowledge as in my own family, in consequence of the instance just described, the question of the transmission of mutilations was actively discussed. In that connection, this case was held up to me as an absolutely trustworthy proof of the possibility, yes, of the fact of such a transmission. The case is the more interesting since it is concerned with the apparent transmission of a scar ["Schmiss"—the term applied to the duelling scars of the German students.—*Trans.*].

A Mr. H. had received, as a student, a serious saber cut, extending vertically along his right cheek, and had retained, during his entire life, the conspicuous scar. Since one of the children of the gentleman, a daughter, brought into the world, exactly on the same spot of the right cheek, a birth-mark in form of a fine red slash, the length of the father's scar, no one hesitated to bring this birth-mark into genetic connection with the cut of the father; and since, in addition, among the five children of this lady, one son also possessed from birth an equally long birth-mark, exactly on the same spot as that of his mother, no one doubted an instant that the scar of the grandfather, an acquired (somatogenic) character had been transmitted to the daughter and the grandchild. Now so convincing as indeed this case appears at first glance, it is yet very far removed from furnishing actually indisputable proof of the transmission of mutilations.

In the first place, I should not neglect to mention that I have known the family in question for many years, without the peculiar inherited birth-mark of the lady or her son ever having attracted my attention, until I was called to notice, and could confirm its actual existence. With the lady, as with her son, the characteristic family mark had been very prominent in the early years of life, it then faded gradually, without disappearing completely, however. The elder Mrs. H., grandmother of the young man, is still living, and, according to her own account, has never possessed such a birth-mark on her right cheek; at present, every trace of one is certainly lacking, so that one is inclined to think of a transmission from the side of the grandfather, the elder Mr. H. Unfortunately, this gen-

tleman died many years ago, and it was on that account impossible for me to determine whether he also did not possess from his birth, such a mark on his right cheek, the existence of which was gradually forgotten,[5] especially, as on this cheek, the large scar and a number of smaller cuts were added.

Besides this possibility, there ought not to be left out of consideration the fact that not infrequently peculiar birth-marks are brought into the world by children, without the same or similar marks ever having been observed in the family in question or among relatives. That sometime such a mark could appear in some child exactly on the spot on which the father had had a cut, is, of itself, nothing surprising, or indeed strange. In a like sense Weismann has already expressed himself, before, indeed, such a case of apparent transmission of a scar had come to light. "I, indeed, do not wish to doubt," says Weismann, "that among the many thousand students whose faces are adorned by so-called cuts, one could be found sometime whose son has a birth-mark on the precise place on which the scar of the father is found. There exist many kinds of birth-marks; why not sometime, then, one exactly on the position and exactly in the form of a scar. Then we would have here a case such as the adherents of the doctrine of the

[5] How easily such birthmarks, especially if prominent only in early childhood, come to be forgotten, may be seen from the following incident: The young man in question, who, like his grandfather, fought left-handed, and has also carried off a considerable number of cuts on his right cheek and forehead, is now father of two children, who show no trace of the family mark. The young wife of the gentleman, whom, as a relative, I have known from early childhood, brought into the world on her brow and scalp a red mark, about 6 cm. long, whereas, among grandparents, parents, sisters and other relatives, such a birth-mark has never appeared. Gradually it has grown rather indistinct, and has come to be forgotten, especially since the "bang" of the child was combed down over the naturally peculiarly high brow. I have convinced myself personally that neither the brother nor sisters of the young wife, nor her husband and other connections, had a suspicion of the existence of the mark. Yes, that she herself knew nothing of it, and could be convinced of the actual presence of this mark only by the assurance of her mother who confirmed my indiscreet statements. At present, moreover, only a very weak, scarcely perceptible trace of this mark is to be recognized. If a child of this couple had brought into the world any birth-mark whatsoever upon the brow, this mark surely would have been brought in genetic connection with one of the cuts on the forehead of the father, since the congenital mark on the mother's brow had long since lapsed into forgetfulness. One would then, with great probability, have spoken falsely of the transmission of a scar.

transmission of acquired characters have long wished, a case of which they think that it alone would suffice to overthrow the entire structure of their opponents. But how far, then, would such a case, if it were really authenticated, be more in position to establish the kind of transmission asserted than the case related by v. Baer, the claim of *Versehen*[6]? I think there lies in the very extraordinary rarity of such cases, a strong indication that there is concerned an accidental, not a causal, occurrence. If cuts could really be transmitted, we should have to expect to meet very often such birth-marks corresponding to the paternal scar, in nearly all such cases, namely, in which the son inherited the features of the father."

From the preceding description we have seen that the apparently so convincing cases of the transmission of former injuries, which I have described, surely do not speak in favor of this theory, which requires nothing less than unimpeachable proof; they accord in part with the cases discussed by Weismann, in which direct proof could be furnished that the peculiarities in

[6] In passing, I should like to mention how prevalent the belief in the *Versehen* of pregnant women still even in so-called educated circles, and should like to relate, only as a curiosity, the following case which occurred also in a family of acquaintances. A Mr. X. went driving with his daughter, who was in the fourth month of pregnancy. By an unlucky chance the pet dog of the young wife fell under the wheels, and was terribly mangled. At the sight of the bleeding animal the horrified woman made involuntarily a movement of the right hand towards the *Kreuzgegend* and behold the timely born, completely normal child, had on the same region a large blood-red spot. Mr. X. assured me that neither in his family nor in that of his wife had a similar birth-mark ever appeared, and so all were agreed that this red mark of the child must stand in direct relation to the movement of the mother at the sight of the bleeding dog. I could only express to the family my warmest congratulations that the young wife possessed such great presence of mind, joined to tender motherly love, that she made the motion of the hand towards just that region, for if, as is wont to be the rule at horrible spectacles, she had covered her eyes with her hand, then the child would have had to bring into the world a peculiar facial ornament, something in the line of a blood-red nose. To go further into detail with regard to the impossibility of the *Versehen* of pregnant women, I regard as superfluous. It is sufficiently well-known that from the moment of the fertilization of the egg by the spermatozöon, the fate of the embryo is decided, both so far as its form as well as its individual *Anlagen* are concerned. Naturally, on account of the intimate connnection of the fruit with the mother, sickness which affects the entire organism of the latter, will also work detrimentally to the embryo, but neither beautiful nor horrible appearances on the part of the pregnant can produce the slightest change in the form of the embryo.

question do not at all correspond in the child and in the father or mother (parent, Weismann), and stand in no genetic connection.

The arguments which oppose the acceptance of the theory of the inheritance of mutilations, have been discussed so much in detail, especially by Weisman and Ziegler, that I shall not refer further to them here. The objections raised have by no means grown weaker of late; they have rather been considerably strengthened by new investigations which give us a deeper insight into the character and processes of fertilization (Weismann's Amphimixis). If now there is no doubt that in the acceptance of the transmission of mutilations, and of the other peculiarities acquired in the life of the individual, the phenomena of the theory of descent find a convenient and simple explanation, this condition by no means authorizes us to an unconditional acceptance of this supposition, since, as Weismann has shown, all phenomena of the theory of descent may also be explained just as simply and unconstrainedly without the aid of the Lamarckian principle. Of special importance for the decision of the question at issue are Weismann's much discussed experiments on mice. As is known, the artificial mutilations of these animals were carried on in both parents through many generations, without any apparent success. Similar recently published experiments of Ritzema Bos, as well as those of J. Rosenthal, showed also the same negative result. If now indeed these experiments on mice, as Weismann states with especial emphasis, alone and without further evidence, by no means furnish direct proof of the claim "that injuries cannot at all be transmitted, since such experiments must be prosecuted even to infinity: yet, indeed, after these unanimously negative results, the possibility of the transmission of single mutilations can be put entirely aside, and the [inheritance of?—*Trans.*] mutilations repeated on both parents through many generations, appear at least very improbable. I, as little as Weismann, Ziegler, and others, desire to doubt that modifying influence of external interference and stimulus on the germ plasm. One can be easily convinced of this, that change of climate, altered conditions of temperature, light and

moisture, different manner of nourishment, transform entirely unmistabably the organism of plant and animal, and there is nothing in the way of the opinion that by the continued working of such external influences and stimuli the molecular structure of the germ plasm also experiences a change which can lead to a transmission of the transformations. Above all, it ought not to be forgotten in this case that the somatic cells are in no way the first to be modified by the stimulus, and that then by some sort of unexplained process (Pangenesis, or intracellular pangenesis) this stimulus is transmitted gradually by these cells to the plasma of the germ cells. The influence on the germ plasm is rather a direct one, and if, by continued influence, a transformation of the structure of this plasm takes place and transmission occurs, then we have simply a transmission of blastogenic, by no means of somatogenic characters, and therein is not the slightest admission of the transmission of acquired characters.

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CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER, FLORIDA, HITHERTO UNEXPLORED.

By Clarence Bloomfield Moore.

Fifth Paper.

General Conclusions.

STONE IN THE SHELL HEAPS.

It will be remembered that the district drained by the St. John's River is destitute of stone; the "rock" of the Indian River, which stream is closely approached by the St. John's near the headwaters of the latter, being a conglomerate entirely unsuitable for the manufacture of piercing or cutting implements.

It will be remembered also that in the shell-heaps of the river, even those giving evidence of greatest antiquity through absence of pottery, through infrequent occurrence of anything denoting the agency of man, and through other indications, implements of stone, though infrequent, have been found at all depths. Professor Wyman was present at the finding at the base of the shell-heap at Horse Landing, (Putman Co.,) of a piece of flint rudely worked, which he pronounced contemporary with the earliest stage of the mound. The writer realizing the importance of this discovery in a shell-heap in which, so far as Professor Wyman's and his own investigations have resulted, no pottery exists, twice visited Horse Landing and made a careful examination of the bluff. The flint in question was found in a section of a shell-heap laid bare by the action of the river, and the writer entertained the idea that the implement was possibly from the talus at the foot of the bluff, in which event the value of the find would have been materially lessened, if not entirely nullified. Fortunately, of all the shell-heaps of the river the composition of that at Horse Landing, most readily lends itself to an accurate estimate of the authenticity of objects found. Unlike the majority of the river shell-heaps, that at Horse Landing does

not rise from the level of the water, but is piled upon a bank of sand a number of feet above the river. All debris from the section laid bare falls a distance below the shell deposit, and an implement found embedded at a point in the sand where the shell begins is considerably above the debris from the section, and must, in the writer's opinion, have occupied that position since the foundation of the shell-heap.

During the investigations of the writer, which covered a period of upward of seven months during the years 1892--1893, steam motive power reducing to a minimum time devoted to transit, several hundred excavations were made in upward of eighty localities. But a small number of objects of stone were discovered under conditions positively identifying them as being contemporary with the construction of the heaps; a number entirely disproportionate, one would think, to the amount of material displaced.

Before proceeding to a detailed account of the worked stone found by the writer in the shell-heaps of the St. John's, it may be well to specify the nature of the conditions referred to above. The writer has had occasion to state in previous papers of this series that the shell-heaps were occupied as a place of residence by later Indians, and that some at least were cultivated by them. The maximum depth of a furrow in a shell-heap is eight inches, and it is probable that the rude implements of the Indians went no deeper. Allowing ten inches as a maximum deposit of surface loam since the final abandonment of the mound, a depth of eighteen inches is arrived at, lower than which it is necessary to go to insure a satisfactory identification as to the period to which any implement belongs.

If, however, sweet oranges are growing upon the shell-heap it is necessary that even a greater depth be attained. It is believed that the sour orange trees, so numerous upon many of the shell-heaps, are descended from sweet trees run wild, planted by later Indians from seed furnished by the Spaniards. Be this as it may a majority of the shell-heaps north of Lake Harney were until a comparatively recent date thickly covered with a growth of sour orange trees. It has been found in Florida that the most available orange trees are derived from

sweet budding upon sour orange stock. After this is accomplished it becomes necessary to place the trees in line and to remove many that no tree may be deprived of sunlight. For the removal of trees and for the "lining" of others, pits three feet in depth are necessary. It is well, therefore, to bear in mind that implements unquestionably of the shell-heaps must be found at a depth greater than three feet in sweet orange groves, and over eighteen inches from the surface in shell deposits not utilized for the cultivation of the orange. The writer, while handling the spade in an orange grove at St.

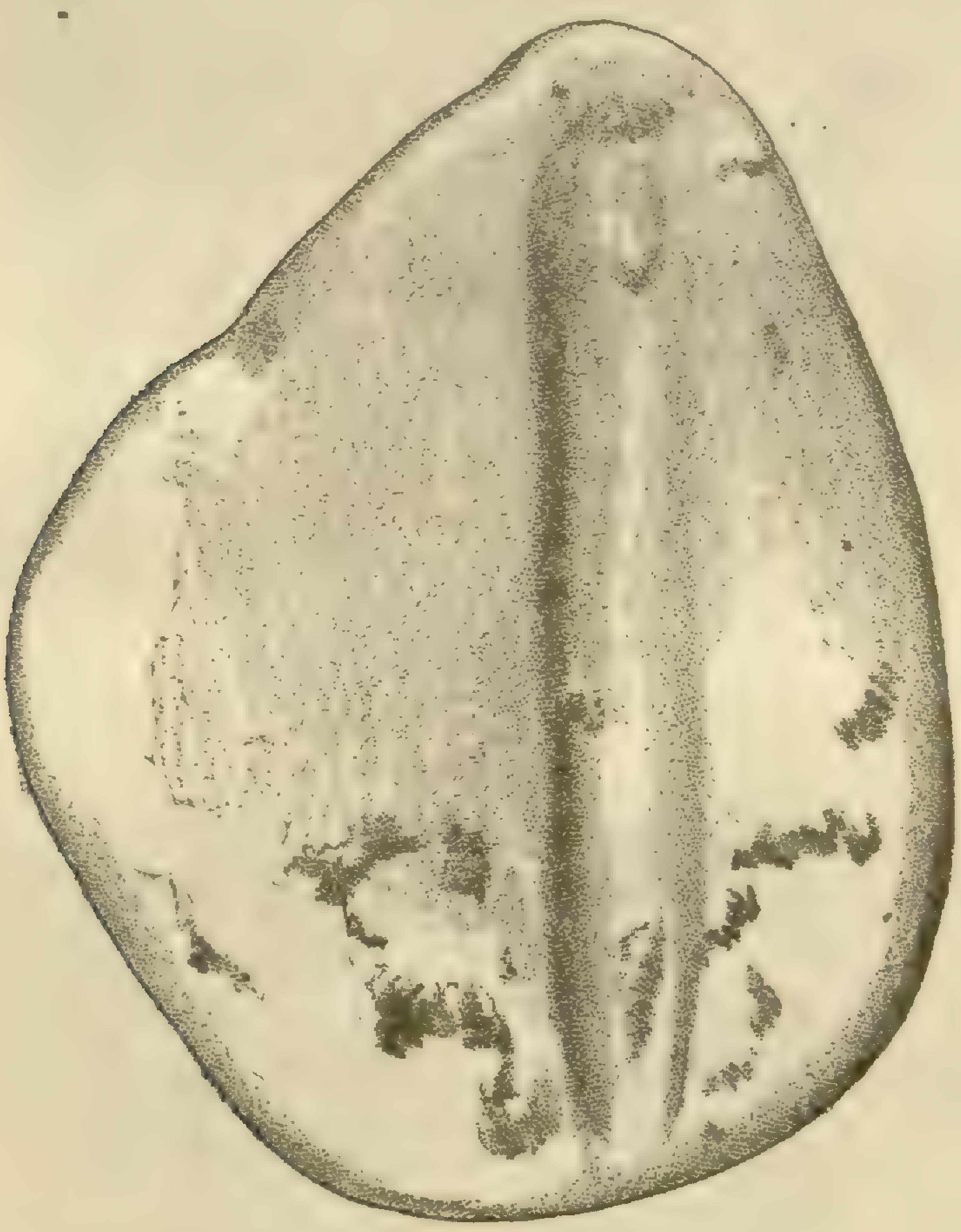


Figure 1.—Grooved Sandstone Hone. (Actual size).

Francis, found at a depth of three feet a thin and beautifully proportioned arrow head, evidently of the time of the later Indians, and conversely he has seen upon the surface in orange groves, arrow points unquestionably of the time of the shell-heaps.

Stone implements known as "sinkers" have never been met with by the writer other than superficially, though hones of sandstone with grooves worn by the friction of pointed tools were contemporary with the later heaps at least. Fig. 1 is from Turtle Mound,[1] Brevard Co.

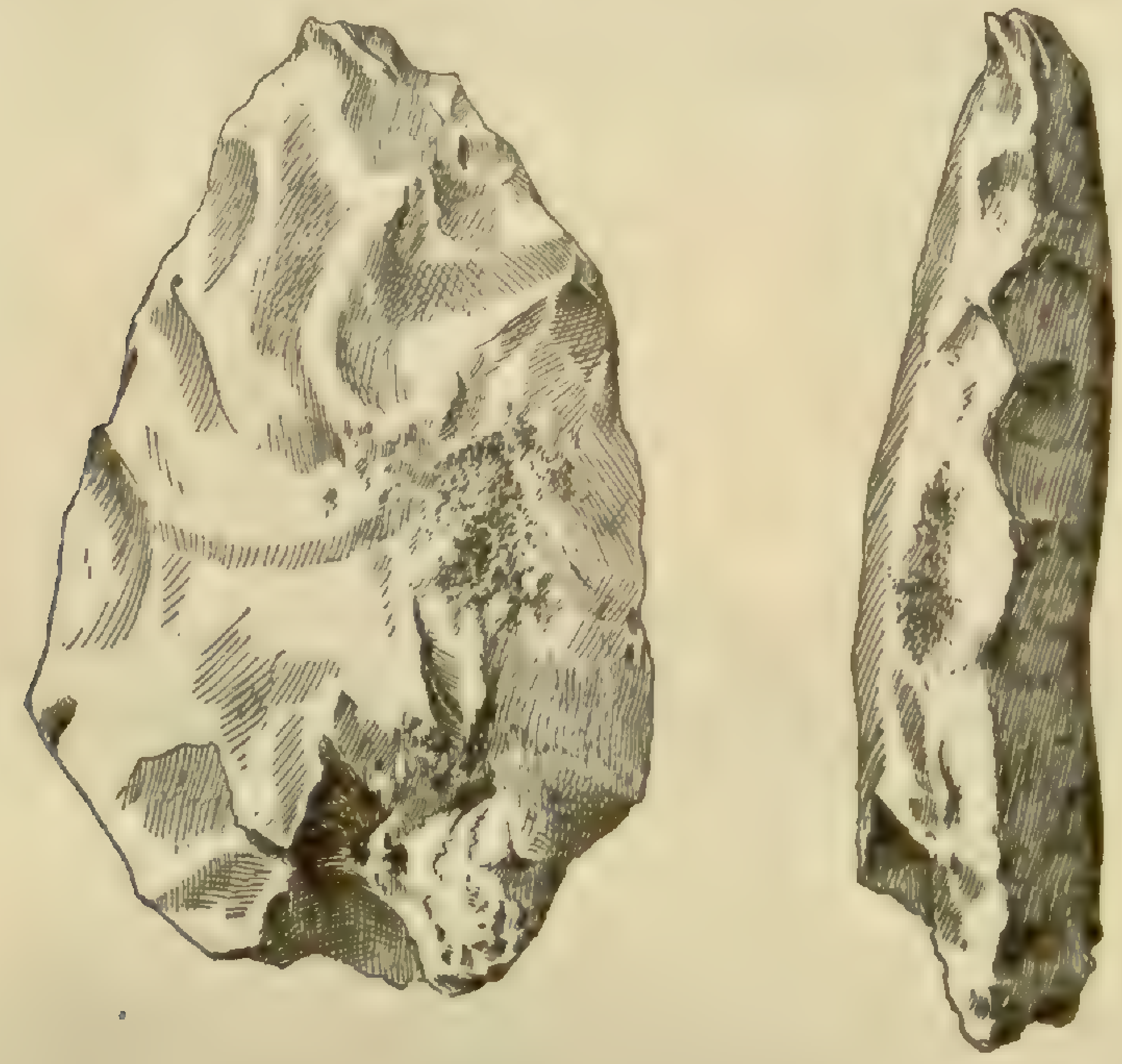


Figure 2.—Arrow Head, Morrison's Creek. (Actual size).

Figure 3.—Arrow Head, Mt. Taylor. (Actual size).

No grooved axes are known to have been found on the river under any circumstances.

[1]Not the great marine shell-heap near New Smyrna.

During the entire investigation of the writer but one implement in any way resembling a chisel or hatchet was brought to light, that could positively be ascribed to the period of the

Figure 4.—Arrow Head, Ginn's Grove. (Actual size).

Figure 5.—Arrow Head, St. Francis. (Actual size).

shell-heaps. This was an implement of polished greenstone figured and described in the AMERICAN NATURALIST, August,

1893. This object, the only one of polished stone known to belong to the epoch of the shell-heaps of the St. John's, was found at a depth of 4½ feet from the surface in Mulberry Mound, Orange County, which is believed to be one of the very latest shell-heaps of the river.

Figure 6.—Arrow Head, shell-heap near Puzzle Lake. (Actual size).

Figure 7.—Arrow Head, Bryson's Mound. (Actual size).

ARROW AND SPEAR POINTS CONTEMPORARY WITH THE SHELL HEAPS.

FOUND IN PLACE BY THE WRITER.

1.—Two arrow heads of chert from the swamp shell-heap near Morrison's Creek, (Volusia Co.,) lying on fire-place four feet eight inches from the surface.[2] Of these, one is figured (Fig. 2). Though carried to a depth of nine and one half feet, this excavation showed no pottery below two feet from the surface.

2.—Two arrow heads of chert and one of chalcedony from the great swamp shell-heap near Volusia, known as Mt. Taylor, (Volusia Co.,) respectively four and one-half (Fig. 3), six and one half and eight feet from the surface. All three lay upon fire-places. A careful search in many parts of this shell-heap showed no pottery whatever.

3.—One arrow head of chert at Ginn's Grove, (Orange Co.,) five miles south of Sanford, at a depth of two feet (Fig. 4). No orange trees grow on this deposit. No pottery found in it, though comparatively abundant in an adjacent shell field.

4.—One arrow head of chalcedony at a depth of six feet on a fire-place in the crescentic shell-heap at St. Francis, (Old Town), (Lake Co.,) (Fig. 5). Many excavations showed no pottery below four and one half feet from the surface.

5.—One arrow head of chert six and one half feet from surface on fire-place in shell-heap west side of Puzzle Lake, (Orange Co.,) (Fig 6). No pottery found below a depth of two feet.

6.—A fragment of spear head of chalcedony at Orange Mound, (Orange Co.,) about twenty-one miles by water

[2]It will be seen that a majority of the arrow heads were found immediately upon fire-places, and of the remainder, the writer is unable to state that such was not also the case. With some were the bones of lower animals. It has been suggested to the writer that as it is unlikely that weapons so comparatively scarce as were arrow points at the period of the shell-heaps, should be lost without some reason, the stone points met with by him were thrown on the fire-places buried in the carcasses of animals. This seems a not unlikely hypothesis.

south of Lake Harney. Deep and numerous excavations gave no pottery below seven and one half feet.

7.—One arrow head of chalcedony in Bryson's Mound, (Volusia Co.,) (Fig. 7). This arrow head was not found when thrown out, but as it lay among material belonging to a stratum not seen within three feet of the surface, its depth may be set down at from three to five and one half feet. Sour orange trees only,

8.—One spear head of bluish chert in the shell-heap on Salt Run, Lake George, (Marion Co.,) at the bottom of the heap three and one half feet from the surface. No pottery found anywhere in this shell-heap below surface loam. No orange trees.

9.—One arrow or spear head of hornstone beveled on both sides 2.34 inches long with maximum thickness of .47 inch, four feet from surface in conical shell-heap in swamp one mile north of Astor, (Lake Co.,) near fire-place. No pottery discovered in this mound beneath surface loam.

10.—Three lance heads about fourteen feet from surface in Mulberry Mound, (Orange Co.). Two of fine chert, thin and of graceful pattern; one of somewhat ruder workmanship fashioned from coarse, yellow chert. These lance points have been described in a previous paper and many reasons adduced why Mulberry Mound must be considered among the very latest of the shell-heaps. Ornamented pottery was found to water level.

As will be seen by the figures, the arrow heads of the presumably earlier shell-heaps are rude in type. They are also characterized by unusual thickness.

Stone implements of the St. John's River are distinctly neolithic, though Professor Wyman in error characterized certain rough specimens found by him as of the St. Acheul type.[3]

The writer has submitted to Professor Haynes a representative collection of rude chipped implements of various sizes, presented to him and reported as coming from the shell-heaps by owners of orange groves and other responsible persons.

[3] Fresh Water Shell Mounds of the St. John's River, Florida, page 49,

These implements Professor Haynes carefully studied, and writes af them as follows:

"No one of them, in my judgment, resembles the genuine paleolithic implements of western Europe, and I am no believer in any paleolithic period in North America different from that of the old world. By this I mean a time when man was living in some regions as the contemporary of animals, now extinct or migrated to colder countries, like the mammoth and reindeer, and had for his principal tool a type of stone implement peculiar in its shape and method of fabrication and of use. Such implements also show upon their surface characteristic indications of their great antiquity. I think genuine paleolithic implements, so understood, have been discovered in the United States, but yours do not fall within that category, in my opinion, although they somewhat resemble them in shape. But so also do many objects found all over our country which must, nevertheless, be classed as rude, or unfinished Indian implements, although they have been supposed to be like genuine paleolithic implements, by some persons not sufficiently informed upon the subject."

FOOD SUPPLY.

While dredging for specimens of modern shells in the lakes, creeks and lagoons in the neighborhood of the St. John's River, the writer had ample proof that the supply of paludinæ is greater at the present time than has previously been reported. Whole lake bottoms are covered with them, while they are found in abundance in numerous creeks and lagoons. The writer knows by experience that the ampullaria and the paludina make a nourishing and not unpalatable soup. Still it is probable that the aborigines varied their diet to as great an extent as possible. Bones of the dog, the red lynx and a member of the sheepshead family of fish, hitherto unreported as articles of diet, were discovered in shell-heaps by the writer.

It is difficult to arrive at a conclusion in respect to the bison, known to have inhabited Florida within a period of which there is historical record. No bones belonging to this animal were found by Professor Wyman, nor has the

writer succeeded in discovering any. A molar, identified by Professor Cope as belonging to a bison, was presented to the writer by Mr. C. H. Curtis of Bluffton, Volusia Co., who stated that it had been superficially found on the shell deposit at that place. It is possible that future investigation will show the bones of the bison to be present in the shell-heaps of the St. John's. Their presence in those of Georgia has been noted.[4]

While the remains of various fish are found in the shell deposits they are by no means so numerous as might be supposed considering their great abundance in the river. The absence at any considerable depth of "sinkers" of stone, believed to have been used for cast-nets, as has been stated, seems to indicate their use as confined to the close of the shell-heap period. Nothing in any way suggesting a fish hook has ever been found in the river heaps. It is probable that the main supply of fish was obtained through the medium of the spear, a method known to have been practiced by later Indians.[5]

AGE OF THE SHELL HEAPS.

There seems to be no reason to doubt that a wide divergence in time characterizes the construction of the shell-heaps of the river, and that many were completed before others were begun. Mt. Taylor, Volusia Co., has a maximum height of over 27 feet. Many and considerable excavations made in every part with an adequate force of men have failed to reveal a fragment of pottery beneath the surface loam. The removal of the entire heap (a work of months) could alone afford absolute proof, but the result of repeated excavations is a strong indication of absence of pottery in the mound.

Mulberry Mound near Lake Poinsett, an island shell-heap rising 16 feet above the water level, is composed of crushed shell and sandy loam, showing slow growth beneath the tread of its inhabitants. Ornamented sherds were met with to the very bottom. Colored pottery was found, and an article of personal adornment, while on a preceeding page has been

[4] C. C. Jones "Antiquities of the Southern Indian," page 200.

[5] The writer has found iron fish spears near the surface of the sand mounds.

related how graceful weapons lay near the base—weapons entirely at variance with the pattern of those of presumably older mounds. The men who dropped the first unios on the low marsh where Mulberry Mound now stands, probably came long after the aborigines abandoned Mt. Taylor. One can readily realize, then, that the shell-heaps are by no means contemporary, and that the beginning of the earliest must date from a period comparatively remote, not, so far as any proofs exist, from a time approaching that of the great mammals, but one far antedating the coming of the whites.

Since the appearance of the first paper of this series, the writer has (1893) carefully gone over many shell-heaps included in his first paper, and has added to the list a considerable number from seven localities. With a force of eight men to handle the spades, the writer has in addition carefully examined nearly all the shell-heaps described by Wyman, and in none has he found any indication of intercourse with Europeans, in this result coinciding with the researches of Professor Wyman.

Numerous objects found by those having shell-heaps under cultivation have been described to or inspected by the writer, but in no case has there been any evidence of the discovery of anything suggesting other than the product of unaided aboriginal industry.

History is singularly rich in accounts of the manners and customs of the natives of Florida, beginning at a period not long subsequent to the landing of Columbus. In all these accounts, written with scrupulous regard for detail, there is nothing to indicate the existence of native races so low in the scale of humanity as must have been those who piled up the greater portion of the shell-heaps. We are told by the Knight of Elvas[6] of the superior quality of the pottery of the Southern Indians. We look in vain in the shell-heaps for evidence upon which such an assertion could have been based. In the face of such a mass of negative evidence, unless proof to the contrary be adduced, the shell-heaps must be considered as abandoned in pre-Columbian times.

A point brought forward in the initial paper of this series

[6]Cited by C. C. Jones "Antiquities of the Southern Indians," page 445.

for the sake of emphasis will be repeated here. In certain shell-heaps at various depths from the surface fragments of pottery, which have gradually been decreasing in number, entirely disappear, indicating, in the writer's opinion, the inception of the manufacture of pottery during the progress of the erection of the heap. The absence of pottery cannot be accounted for under the hypothesis of decay, since no stratum containing partially decayed sherds is met with in any of the river shell-heaps. If the occurrence of shell-heaps devoid of pottery is admitted on the St. John's, and as to this a careful investigation can leave no doubt, it would be difficult to assign a reason for the absence of this necessity of aboriginal life, save ignorance of the method of its manufacture,[7] and assuming this to be the case, there would seem to be no cause why certain shell-heaps should not show by internal evidence the inception of the art.

In conclusion, the writer would state as his opinion, that while the shell-heaps of the St. John's have been imperfectly explored, and while many interesting questions still remain unanswered, but little work will be done in connection with them in the near future. The territory to be covered is so vast, and the shell-heaps of the upper river are so inaccessible that one may well hesitate before undertaking an exploration involving so much trouble and expense. Moreover, but little is found in comparison with the vast quantities of debris to be handled, and the relics of the wretched makers of the shell-heaps offer but a poor incentive in comparison to the more alluring results to be attained in other portions of the country.

[7]It has been asserted that the absence of pottery in certain shell-heaps is explainable under the hypothesis that the people frequenting the shell-heaps dwelt there for but a portion of each year and made the earthenware vessels elsewhere. This seems untenable. It matters lttle where the pottery was made. If possessed by the occupants of the shell-heaps it certainly would be *used* there, for numerous fire-places and broken bones at all depths testify to culinary pursuits. Earthenware is too brittle to allow one for an instant to suppose that numerous vessels would not be broken as they were on so many shell-heaps. Moreover it is difficult to comprehend why some shell-heaps should be marked by the manufacture of earthenware, while others give no evidence of its production. Rude masses of baked clay and in one case a vessel filled with clay unbaked were found by the writer in shell-heaps.

The conclusion seems difficult to escape that where earthenware is not found, its manufacture was unknown.

PERIGONIMUS JONESII; A HYDROID SUPPOSED TO BE NEW, FROM COLD SPRING HARBOR LONG ISLAND.

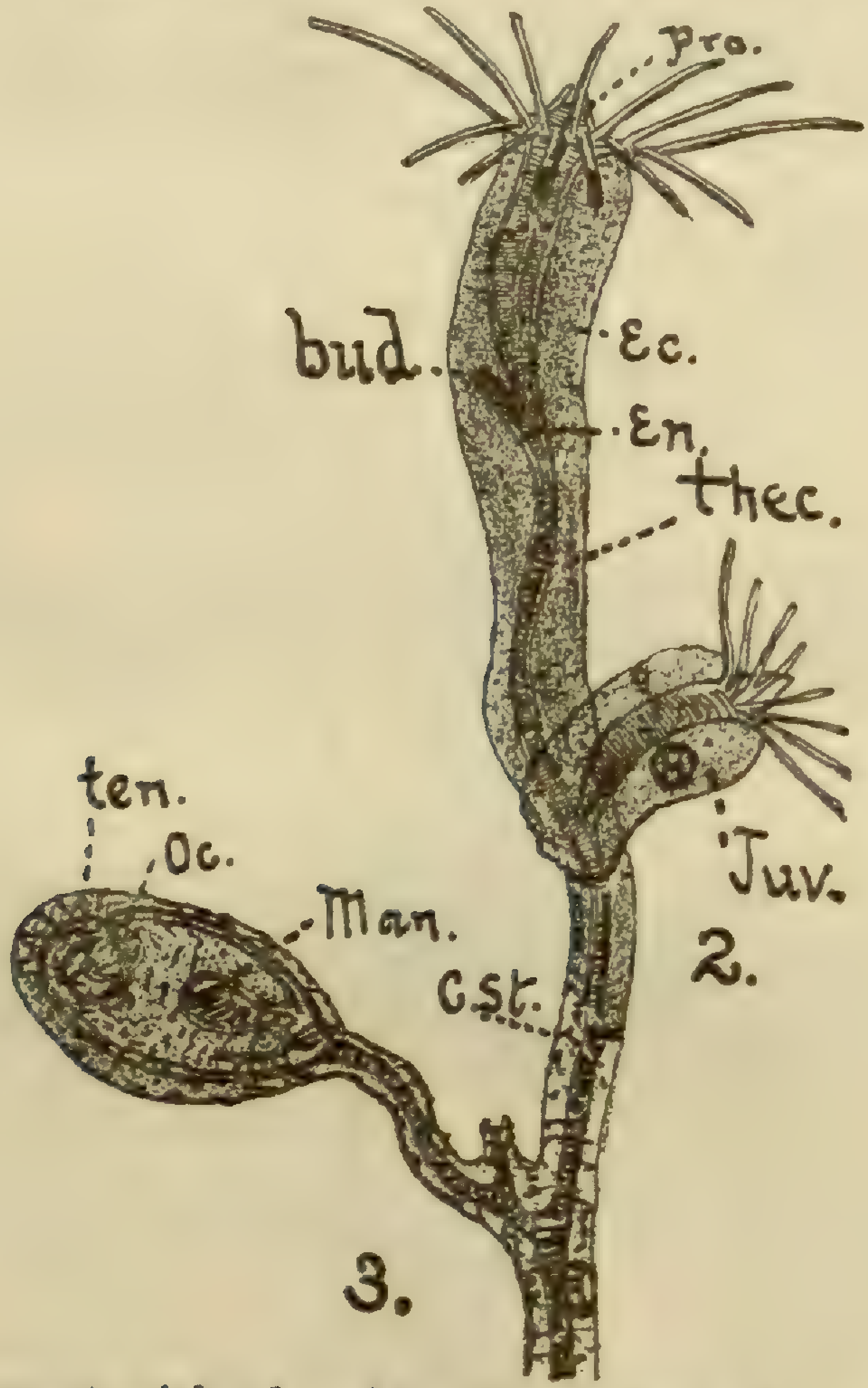
By Henry Leslie Osborn and Charles W. Hargitt.

The authors of this article, while engaged in seaside studies at Cold Spring Harbor, at the Laboratory of The Brooklyn Institute, found a certain hydroid which is the subject of this

article. A careful survey of the accessible literature of the subject has failed to demonstrate that it has been previously described, though its very common occurrence together with the ease of its capture render it remarkable that it should have escaped the hands of the collector heretofore. It is a very interesting species on account of the very primitive state of development of the integument, if we may so call the theca or skeleton, and hence of interest to the biologist, for whose sake,

rather than merely for the sake of its faunal interest, these notes are written.

The species occurs very commonly as a flesh-tinted scum on the abdomen or on the tips of the joints of the walking legs (pereiopods) of the Channel Crab *Libinia emarginata.* This crab lives abundantly a very lazy life in the deeper waters near the mouth of Oyster Bay and in the bays and sounds gener-



ally that connect with the Atlantic Ocean in the latitude of Long Island. If specimens of the crab be placed immediately upon capture in an aquarium, the hydroid, if present, can be seen as a fleshy fuzzy mass in the midst of the rather abundant hairy material that covers the creature on the ventral surface quite generally. The hydroid is thus a messmate of the crab, but there is no proof that I know of that the latter is in any way affected by the presence of this lowly companion. There is a disease of a certain fish caused by the presence of a parasitic hydroid described by Fewkes as *Hydrichthys mirus*

[Bull. Mus. Comp. Zool., Vol. XIII, p. 224]. In this case however, it was not certain that the parasite did any damage to the fish. It is not impossible that a hydroid could get into such a relation to the soft tissues of a crab at the joints as to be a harmful resident there, but we know of no proof that such is true of *Perigonimus jonesii.*

An examination of the colony with the low power shows that it is a very much branched mass of stalks arising from stolons that ramify on the surfaces offered by the shelly outer covering of the host. The colony is, unlike most of the other species of this genus, very closely and luxuriantly branched, and the two kinds of persons are both carried on the same stalk. The stalks are terminated with one oldest zooid and below it are the younger ones and the gonozooids. The hydriform persons or hydrozoids are, as shown in figure 2, only slightly differentiated into a body separate from the stem and in this respect it is of the more primitive hydroid form. The tentacles are not numerically constant but are about sixteen in number. They tend, when fully expanded, to assume an alternately reflexed position. They are confined to a single row at the base of the

proboscis. This is also a primitive character. The stem just at the base of the body proper of the hydrozooid bears a little bud not sufficiently developed to project beyond the outline of the cuticle. The interesting thing about this hydroid to the biologist is the very primitive condition of the external skeleton. This is a gelatinous investment that covers the stem and the body in every part. It is so soft and flexible that it follows all the movements of the body and stem without any apparent resistance. This cuticle reaches upon the body to the level of the tentacles to which it is fastened, as is shown by the fact that it is moved about with them as the animal waves them to and fro, and it is retracted with them as the proboscis is drawn

down to the slight extent that is possible to the animal. The covering is of the most delicate texture but strong enough to hold firmly together in all the movements of its possessor. In the older parts the cuticle is somewhat more opaque and is more or less stuck up with dirt and such things.

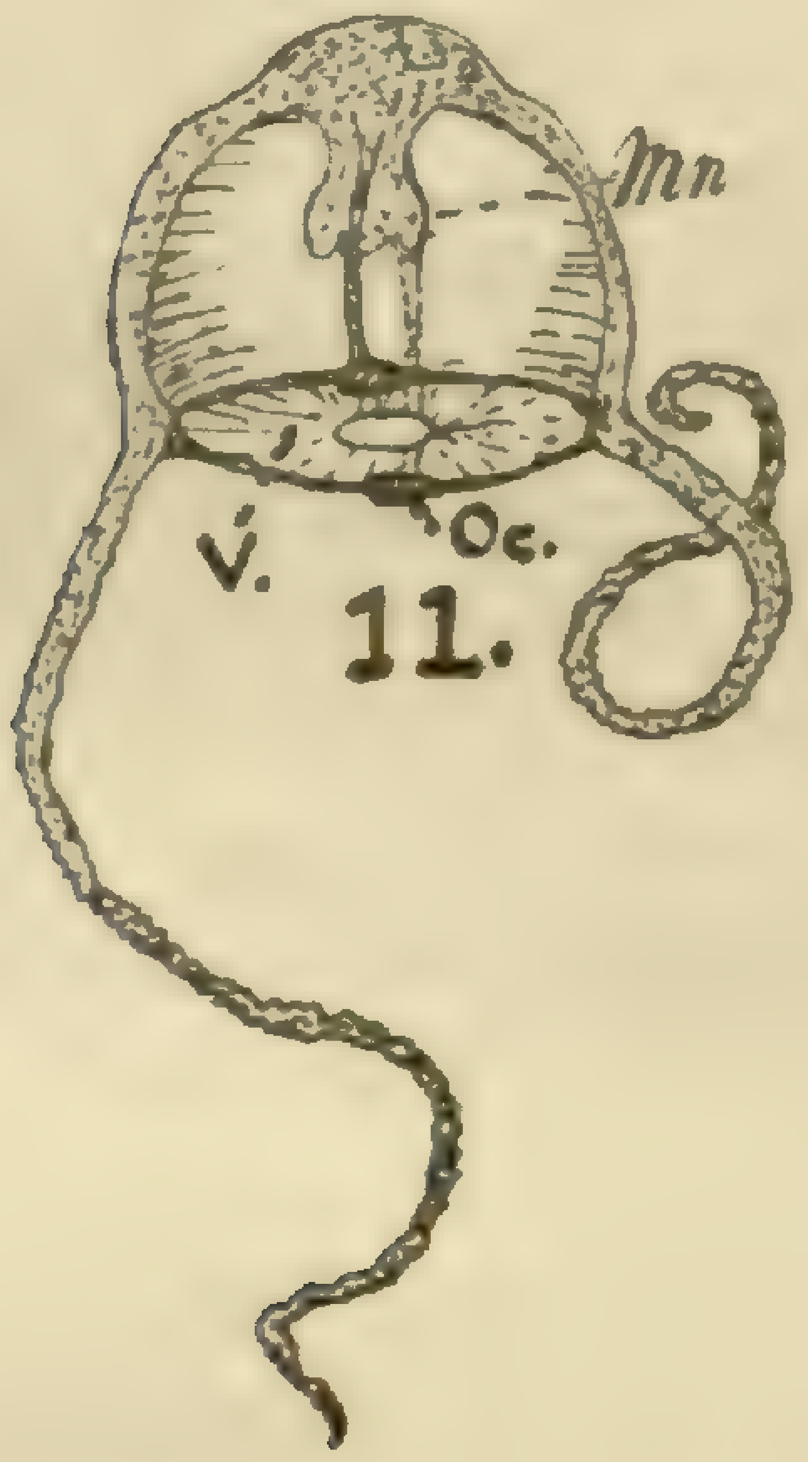
The gonozoids are budded in clusters from the sides of the stem near its centre, they have an investment of cuticle which eutirely covers them, and the bell develops to its time of release but not to its maturity in this case, and can then be seen to break off from the parent stock and swim away for itself. The stages in the development of the bell are as usual in this order. They are as follows. It appears as a minute bud on one side of the stalk, and not for some time can it be seen whether it is to give rise to a medusa or to a polyp. An enlargement into a somewhat spherical head usually indicates the medusoid character of the bud. This process is quite gradual as may be seen from the figs. 4, 5 and 6, all of which, while somewhat diagrammatic, were sketched directly from living or preserved and mounted specimens. As has been said, they follow the general course of development common to the order. *Cf.* Lang, Comp. Anat., p. 105, *et seq.*

The first differential change that occurs is a thickening of the peripheral ectoderm at the extremity of the bud, with an accompanying invagination extending to the entoderm; fig. 4. This continues as shown in figs. 7 and 8. In this process

there occurs what may be designated as a cleavage of the ectoderm of the outer margin of the bud, and which extends for some distance around the bell, fig. 8. The outer portion constitutes the outer ectodermal envelopes of the medusa, and is ruptured and finally atrophies at, or immediately before, the

final separation of the medusa. The inner layer of the ectoderm continues to invaginate, making the ectodermal lining of the bell, and giving rise to the tentacles and velum. *Cf.* figs. 9 and 10.

From a glance at figs. 11 and 12, it will be seen that the



11.

12.

tentacles are relatively very long, but in mature specimens they are much longer than represented. Their disposition during the period of development is quite interesting. It is measurably indicated in fig. 9. They are from the first turned inward and soon enter the interior of the bell, being nicely folded and filling the entire cavity. This habit is not abandoned immediately on the separation of the medusa. In many cases under observation the medusa, when suddenly disturbed, would at once contract the tentacles, and, seeking the mouth of the bell, dispose them within, and at the same time assume an almost spherical form and thus remain for some time or till the disturbance ceased.

The development of the radial and circumferential gastric canals proceeded, *pari passu*, with the growth of the medusa. This was very easily demonstrated by the active circulation which was observed extending to the very tips of the tentacles and over the middle of the bell to unite with the circumferential canal at the optic spots. No special histological investiga-

tions were made, but it seemed highly probable that the canals arose after the manner described by Lang, (*op. cit.* p. 73.)

The development of the manubrium calls for no special account. Its origin is illustrated in fig. 9, it is also shown in fig. 3.

The origin of the mouth is simply through the rupturing of the terminal walls of the manubrium, and was observed in several cases, and seems to be after the method common throughout the order so far as known.

There is not the least difficulty in obtaining the young medusa or in keeping them alive in aquaria for a considerable period of time. We had them as long as fifteen days and examined them constantly, but we did not succeed in rearing them to maturity. At the time of their liberation from the hydroid stock the reproductive organs had not yet made their appearance.[1] Perhaps a later study of this creature will disclose a way in which this important link in the life history can be discovered. Until this important fact, the definitive form of the medusa, is supplied, the generic affinity of the species must remain in uncertainty. There are indications enough, however, to justify its provisional assignment to the genus Perigonimus of Sars. Not only are the structure of the hydroid stage and the structure of the young medusa, in favor of this, but this species shares with nearly all of the remaining members of the genus the habit of commensalism. Thus *P. repens* is found on the shells of the hermit crab, *P. minutus* lives on the shells of Turritella, *P. vestitus* is attached to the shell of Buccinum, and *P. repens* is reported from the shells of Libinia in the British Islands. The form we are now considering, while it is generically related at least in the hydroid and early medusoid stage to the Genus Perigonimus, is not, so far as we have been able to learn, specifically related to any described species. We have, therefore proposed to give it the name *Perigonimus jonesii*, to commemorate the founder and constant friend of the Cold Spring Biological Laboratory, Dr. Jones. The great luxuriance

[1] In one instance, figured in No. 12, one of the tentacles was bifid. It was distinctly double from the point of its origin and was plainly a monstrous character rarely found. Each portion of the tentacle was moved independently but both tended to be retracted together on stimulation.

of the branching, together with the origin of the medusæ from the stalks bearing the hydroid members, and the presence of several medusæ originating at a common point of attachment to the parent stem are the specific characters that have required the erection of this new species.

For convenience the species of the genus are summarized here.

P. repens, tentacles all erect, about 18–20, medusæ and hydroids simple, arising separately from a creeping hydrorhiza, young medusa bi-tentaculate.

P. minutus, tentacles 7, medusæ arising from the simple or very sparingly branched hydroid persons, on shells of Turritella.

P. vestitus, tentacles 8, alternately reflexed, medusæ arising either from the hydrorhiza or from the hydroid person, not in clusters; hydroids not branched, young medusa bi-tentaculate, On shells of Buccinum.

P. palliatus, tentacles, 8 alternately reflexed, thick gelatinous coat as far as the bases of the tentacles, gonophores arising from the hydrorhiza. On shells of the hermit crab.

P. jonesii, tentacles 16, alternately reflexed, thick gelatinous coat as far as the bases of the tentacles; medusæ and hydroids on the same stalks, hydroids luxuriantly branched and mudusæ clustered, young medusæ bi-tentaculate. On shells of Libinia.

To the morphologist a form like the one just described has peculiar interest because of the many primitive characters which are united in it. It is not improbable that the higher calyculate Campanularian Hydroids may have been descended from athecate ancestors that were more or less closely like the genus Perigonimus. This is a very lowly form of the tubularians, having only a single row of tentacles, the mode of reproduction is very simple, and the medusa is of a most simple character. Still while Perigonomus is treated among the naked hydroids, it has a covering. This covering is such a one as such an animal as the naked hydroids might have in their earlier stages of the acquisition of a strong skeleton. It is not a highly differentiated product, but a delicate, hardly compacted slime not very unlike the mucous secretions that all

animals are so commonly throwing off from their bodies. If the semi-fluid coat of this sort were stiffened only a little, we should arrive at the more compact chitinous cuticle of the calyculate forms. The case of Perigonimus thus furnishes a suggestion of the probable history of the chitinous cuticle of the hydroids; at first a thin envelope, later a stiffened cover forming a greater protection to the body and providing for freedom of motion by the development of joints at stated intervals. The facts of ontogeny are in favor of such a view of the history of the cuticle, for we know that the cuticle arises as an excretion thrown off from the ectoderm and hardened on exposure to the water. And the differences between the gelatinous and the chitinous cuticle, are such differences in the chemical or metabolic functions of cells as could conceivably easily come within the range of operation of natural selection. It is of great interest then to find so primitive an animal with so primitive a mode of skeleton building, and whether the creature is really a primitive one or its primitive characters are only secondarily acquired it is one the entire life history of which would be full of interest.

Explanation of the Figures.

Fig. 1.—View of general mode of branching and situation of medusæ. *a* hydrorhiza; *b.* hydroid person; *c.* medusa bud; *d.* the gelatinous cov. *e.* a young hydroid bud.

Fig. 2.—Enlarged view of the terminal zooid showing the body, "ec," "en;" and the covering "thec;" the proboscis, "pro;" and a younger zooid, "juv."

Fig. 3.—View of a single one of the medusæ in position. *c. st,* the stem of the colony; *man.* the manubrium inside the bell; *oc,* the eye-spot at the location of a tentacle; *ten,* a tentacle.

Figs. 4, 5, 6, 7, 8, 9, 10, different successive stages in the growth of the medusa.

Fig. 11, a medusa just freed from the colony; *mn.* manubrium, *oc,* ocellus; *v.* velum.

Fig. 12, view of an exceptional specimen showing bifurcated tentacle.

Hamline, Minnesota, July 19th., 1893.

COURTSHIP AMONG THE FLIES.

J. M. ALDRICH.[1]

The dipterous family Dolichopodidae perhaps surpasses all other families of animals in the variety and complexity of the sexual adornments of the males. These structures occur in some species in the tarsi, in others in the antennæ, face, wings, or other parts. Probably three-fourths of the species offer well-marked peculiarities which distinguish the male at a glance.

In the genus Dolichopus, the males are usually provided with tarsal ornaments, usually on the fore limbs. A new species, to which the following remarks apply, has the fore tarsi in the male exceedingly elongated and slender, with the last joint in the shape of a comparatively large, oval, black disk. In none of the numerous other species known to me is the attenuation of the first three joints so great. The tarsi of the female are of the ordinary simple structure.

This species is abundant about the edges of the streams, on the wet, bare earth, at Moscow, Idaho. I observed in September the maneuvers of the male in courting the female. He would place himself directly in front of her, at a distance of about half an inch, with his face toward her. He would then rapidly vibrate his wings, holding them horizontally, at right angles to the body, and at the same time would give these fore feet an up-and-down motion, raising them simultaneously above the level of the head and bringing them down with a slight force upon the ground, the movement recurring in a measured way in about half a second. This he would continue for some ten seconds; then, rising on the wing, he would swiftly make a small semicircle in the air and attempt to alight upon the female. In the large number of cases that I observed, he was always unsuccessful, the female hastily moving away a few inches, when the male would usually alight before her and repeat the movements just described. On account of the numbers that were engaged in this occupation on the same small area, I could not be certain that the same male always

[1] Moscow, Idaho.

attended upon a given female; but there can be no doubt that the females are exceedingly slow to accept the males, for I saw the above maneuver repeated hundreds of times with the same result.

In company with the species just mentioned occurred considerable numbers of a species of Hygroceleuthus, which I have referred to (Kans. Univ. Quarterly, II., 24) as a variety of *H. crenatus* O. S. These were engaged in a similar occupation. The male of this species has only plain tarsi, but differs from the female in having the antennal joints longer, the first two with coarse black hair, and the arista of the third short and heavily covered with black pubescence; the face is also longer, the wings broader, and the cilia of the tegulæ, instead of being coarse and chiefly black, are fine and white. The male hovers in the air before the female at a distance of one or two inches, occasionally making a slight darting motion towards her. In this position the peculiarities of his face and antennæ are shown to the best advantage. The breadth of the wings is probably of advantage only in facilitating this hovering process, and the structure of the tegular cilia may possibly be accounted for by supposing that it is simply in compensation for the increased growth of wings. This male, after hovering a few secends, describes a semi-circle in flight and attempts to alight upon the female as in the foregoing species, and with the same results. I observed the copulation only once, and then did not see the preliminaries.

I was much impressed by the perfect coincidence of these observations with Darwin's theory of sexual selection. The reluctance of the females, and the corresponding ardor and persistence of the males, is carried to an almost incredible limit.

In this connection the observations of Fr. Dahl (Zool. Anzeig., April, 1889) on another species of Dolichopus are of interest. I translate from a quotation in an article by Dr. W. M. Wheeler (Proc. Wis. Nat. Hist. Soc., April, 1889, p. 209), which mentions a somewhat similar habit in a gall-gnat *Asynapta antennariæ* Wheeler).

"The male species of fly, *Dolichopus plumipes* posseses on first tarsal joint of the middle legs a beautiful, regular fringe,

the purpose of which is not immediately perceptible, as the flattened hairs could not possibly serve to grasp the female. I have now observed the pairing of these insects, and am convinced that the structure serves as an actual ornament to the male, like the highly developed tail-feathers, etc., of a male bird. The male came flying up, and hovered for a time so close over the quietly-resting female that the fringed tarsi hung down immediately before her eyes. After some time copulation was attempted, but the female at once showed unwillingness. Only after repeated attempts did he succeed in gaining her acceptance."

EDITORIALS.

—THE edict of the Czar whereby the town of Dorpat is hereafter to be known as Juriew, and its university, where heretofore the lectures have been in either German or Russian, is to be thoroughly Russian now, suggests a question which is rapidly becoming a serious one to the scientific world outside of Russia. This is, what shall be done with the numerous papers published in the Slavic tongues? It is a serious task for the student to acquire a reading familiarity with the various Teutonic and Latin languages. Russian, Czech, and Polish, are almost impossible. And yet the tendency on the part of the Russian Government is to compel the exclusive use of that tongue. It is hereafter to be the language of all publications coming from the University of Juriew. Must the student of science hereafter add a knowledge of Russian to his other linguistic attainments? or is he justified in neglecting all Sclavic productions, just as he would those in Japanese, until they are translated into one of the languages previously in scientific use? Cannot our various International congresses discuss the question as to what languages shall be recognized as the proper vehicles for the publication of the results of research, and come to some agreement whereby all papers printed exclusively in languages outside those of the Teutonic and Roman stocks are to be regarded as not published. Protests by the Western World are of no avail with the Czar, but the fact that the difficulty is such as to produce a practical boycott may produce good results.

Since writing the above a case to the point has arisen. In the last number of the "Morphologisches Jarbuch" the brilliant embryologist, Goronowitsch, takes Miss Julia B. Platt to task for ignoring previous literature. The facts are these. Miss Platt announced that the cartilages of the vertebrate head are ectodermal in origin, and in support of her views she quoted from the available literature, including one paper by Goronowitsch. Mr. Goronowitsch complains that she neglected two other papers by himself, one of which was in Russian.

—THE city council of Philadelphia made an appropriation for the purpose of securing certain collections of objects of Natural History which were exhibited at the Exposition at Chicago. The matter was placed in the hands of Professor W. P. Wilson of the University of Pennsylvania, who carried out the object of his mission successfully, as he has

obtained a large amount of valuable material. It is now proposed to erect a building for the purpose of accomodating the collection. To this proposition it may be objected that we have already in Philadelphia a sufficient number of buildings adapted to museum purposes, so that to erect a new building is to divert money from a more important object, viz., that of securing the care of the specimens, and their use as means of scientific research. The expenditure of money for museum buildings has secured enough space and shelter for the materials of research and for the investigators for a long time to come, so that the endowment of scientific research should now claim attention. An appropriation for this purpose would be of more utility than any other that can now be made, for it has been a necessity in the community for a long time. Scientific results can not be expected without provision for investigators, and this is lacking in almost all our institutions.

—Two prizes have been offered by a member of the Anthropological Society of Washington for first and second essays which shall contain a definition of the "Most useful citizen of the United States regardless of occupation." In our next number we will give the details of the plan in full. Such a definition may be summed up in a few words, or it may cover the fields of social and political science. We shall look with much interest to the responses which this offer shall bring out. Men's ideas of the highest utility are various, and, they differ as well in regard to utility in detail. Many persons possess a bias in favor of their own pursuits, which is natural. So far as this project encourages thought, and stimulates serious endeavor, it will be itself of no small utility.

—We must again request our **correspondents** and **exchanges** to send M.S. and printed matter of all kinds, except proofs, to the office of the editor 2102 Pine Street, Philadelphia. We except of course such as are designed for the use of our Editors of departments. This course expedites their reception and acknowledgement at all times; and when we change publishers as we occasionally do, such matter is apt to be lost.

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RECENT LITERATURE.

The second and concluding part of J. Roth's Allgemeine und Chemische Geologie[1] completes the valuable set of volumes the first two of which have proven such a boon to chemical and petrograpical geologists. That portion of the volume before us has been edited by the author's daughter, who has attempted to present the subject matter contained in it as nearly as possible in the form in which it would have appeared had her father lived to complete his work. The title of the book describes the nature of its contents. The discussion relating to the weathering of rocks comprises 59 pages, on many of which are found analyses that serve to illustrate the subject. Seventy-two pages are devoted to the decomposition of rocks through the influence of volcanic and other examinations from beneath the surface of the crust and thirty-two pages deal with rock distintegration consequent upon temperature changes, the action of organisms, and the effects of wind and water. Three appendices to the three volumes follow, and to each there is added an excellent index. The brochure just issued, like all the others that have come from the pen of its author, is a masterly and thorough treatment of the subject of which it treats. It is a fitting capstone to the excellent monument which the authors reared to himself during the concluding years of his life. It is so replete with interesting information that it must prove a necessity to every student of rocks. W. S. B.

Our Household Insects.[2]—Under the title Mr. Edward A. Butler has written a book which is decidedly better as regards accuracy coherence and scientific value than the usual popular works on entomology. Eighteen chapters are utilized to discuss a great variety of household insects—many of which in America at least could only rarely be viewed in the light of " pests ": the list includes wood boring, clubhorn and long-horn beetles, meal-worms, ants, wasps, horn-tails, clothes moths and meal moths, crickets and ear-wigs, flies of many kinds including gnats, midges and mosquitoes, the flea and bed-bug, the booklouse and " silver-fish " and lastly human Pediculi. Besides a consider-

[1] Allgemeine Geologie, von Justus Roth. 2te Abt. Verwitterung, Zersetzung und Zerstörung der Gesteine. Nachträge. Berlin. W. Hertz., 1893. Pp. 211–530 and ix.

[2] Our Household Insects: An Account of the insect pests found in dwelling-houses. By Edward A. Butler, Longmans, Green, and Co.

able number of fair illustrations in the text, there are seven page-plates showing photographic enlargement of various insects.

Horns and Hoofs[3].—This octavo volume of 411 pages is a reissue in a collective form of articles which have appeared from time to time in the *Field* and *Land* and *Water*. The animals come under the designation of "big game," and include the wild oxen, sheep and goats, the Asiatic and African antelopes, the Asiatic and South American deer, the wild pigs, and the rhinoceroses, ancient and modern. In some of

Fig. 1. *Oryx gazella*, the gemsbok of Africa.

the chapters all the members of particular groups are discussed, in other cases, while the geographical distribution of all given, the author limits the full description to the more important members. The relations existing between the different groups and the past distribution of each particular group are treated of more at length than is customary in the majority of sporting works. In fact the book rises much above the general level of this class, as it could not fail to do as the work of Dr. Lydekker, who is one of the most competent of modern zoologists.

[3] Horns aand Hoofs or Chapters on Hoofed Animals. By R. Lydekker. Horace Cox; The Field Office, Windor House. London, 1893.

His long residence in India gives him especial authority on the Mammalia of that region, and we accordingly find his descriptions of some of the little known species of the oriental mountain ranges to supply a long feet desideratum. These remarks are especially applicable to the wild species of sheep and goats. We find the work lacks symmetry in the inclusion of the rhinoceroses while it omits the tapirs and horses; and a strictly scientific limitation would include also the Proboscidia. Perhaps these forms can be added in a future edition. In any case it is a book which no sportsman or naturalist can not be without. It is illustrated by 82 excellent cuts. Through the courtesy of the publisher, we are able to reproduce two of them.

Fig. 2. *Atelodus bicornis;* the common African rhinoceros.

General Notes.

GEOGRAPHY AND TRAVELS.

The Ascent of Mount St. Helens.—The following abstract of an account of the ascent of Mount St. Helens by Mr Fred. G. Plummer, prefaced by a brief history of its recent eruptions, appeared in the December number of *Scientific American:*

"St. Helens has shown considerable activity in recent times. In August, 1831, there was an uncommonly dark day, which was thought to have been caused by an eruption of a volcano. The whole day was nearly as dark as night, except for a slight red, lurid appearance, which was perceptable until near night. Lighted candles were necessary during the day. The atmosphere was filled with very light ashes, like the white ashes of wood. The day was perfectly calm. There were no earthquakes or rumblings. After the ash clouds had cleared away it was seen that the pure white snow upon St. Helens was browned by the fall of ashes. It is also said that lava flows took place at that time."

"In October, 1842, St. Helens was discovered all at once to be covered with a dense cloud of smoke, which continued to enlarge and move off in dense masses to the east, filling the heavens in that direction. When the first volume of smoke had cleared away it could be seen distinctly from various parts of the country that an eruption had taken place on the north side of St. Helens, a little below the summit, and from the smoke that continued to rise from the crater it was pronounced a volcano in active operation. When the explosion took place the wind was morthwest, and on the same day, extending from thirty to fifty miles to the southwest, there fell showers of dust or ashes, which covered the ground in some places so as to admit of its being gathered in quantities."

"On November 23, 1843, St. Helens scattered ashes over the Dalles of the Columbia River, fifty miles away, and burned continuously until February 16, 1844. Dense masses of smoke rose from the craters in immense columns, and in the evenings the fires 'lit up the mountain side with a flood of soft yet brilliant radiance.'"

"Having determined to investigate the most active volcano of Washington, we left Tacoma by the midnight train, August 10, 1893,

with packs containing necessaries for the trip and the instruments for observing and recording all we were to see."

"When we reached the mountain, with the aid of a glass I was able to map out a route to the larger of the craters which would not cross any of the great crevasses in the ice slopes. Our ascent began immediately, and in less than an hour became very steep and in places dangerous. Our progress was checked by an enormous cañon, several hundred feet deep, which appeared a counterpart of the great cañon of the Yellowstone. Its formation showed several old lava flows, which, being firmer than the cinders and broken rock, in most places overhung the walls of the cañon and made descent out of the question. The great glacier át its head was fully 100 feet deep at the foot, and was ploughing its way into a huge terminal moraine of small rocks. We could plainly hear the rocks grinding together as the great body of ice slowly forced them down the cañon. This great glacier headed in the ice cap at the summit of the mountain, and, although it looked steep and slippery, we decided to try the route. It was then 10 o'clock in the morning—a bad time to climb ice slopes aud snow fields—but we had been gone from Tacoma nearly a week and had only provisions for two more days. We had proceeded but a short distance cutting steps in the steep ice slope, when a bombardment of rocks warned us that our route was to be a dangerous one. The surface of the glacier seemed a sheet of ice clear to the summit, and down its slippery surface came rocks large and small as fast as the noonday sun melted the ice and snow which held them near the top."

"Imagine a toboggan slide about three miles long, starting nearly 10,000 feet above the sea with an initial grade of forty-five degrees. The speed of the rocks as they passed us was terrific. They whirled at such a rate that they seemed spherical in form, and as they flew down the slope seemed only to touch the high places in the slightly wavy surface of the glacier, making a metallic sound as they clipped the ice into a cloud which trailed them like a comet's tail. Here and there great rocks lay upon the surface of the glacier, probably having been held by a fall of new snow, and now and then one of these flying rocks would strike those which were held by the ice, and, amid a shower of sparks and chips, would bound into the air fifty feet or more, still whirling like a buzz saw and giving out a sound which I cannot describe. All this would have been very entertaining if so many of the flying rocks had not passed near us."

"We were exposed to this danger for over an hour while climbing a quarter of a mile, and to say that we were all thoroughly frightened

would not do the rocks justice. When at last we reached a place of comparative safety, we were too much much awed to speak."

Source of the Mackenzie River.—Up to the present time the Mackenzie River has never been traced to its head, and its source has only been known from Indian report. The mystery has been solved by Mr. R. G. McConnell of the Dominion Geological Survey, who has just returned from a four months' exploration trip in those regions. The following account of his trip is taken from the *Vancouver News-Advertiser* :

"Mr. McConnel arrived in British Columbia from Ottawa in June, and started out on his trip fron Quesnelle on the 9th of that month. The party numbered six in all and consisted of himself, his assistant, Mr. Russel, two whites he engaged at Quesnelle and two Indians. From Quesnelle the party proceeded in canoes up the Frazer to Giscome Portage. This is seven and a half miles long, aud after crossing it they proceeded down Crooked River to Fort McLeod. Their route then lay down Parsnip River to the forks, where Findlay River meets the Parsnip and gives birth to Peace River."

"On reaching Findlay River Mr. McConnel really commenced his summer's work, as the chief object of his trip was to explore that river and, if possible, the Onimeca also. Mr. McConnel accordingly went up Findlay River to its junction with the Onimeca, and followed the latter river to its head, returning down it again to the same spot. This river is easy navigable on the upper portion, but in the first thirty miles it falls over 500 feet, and is consequently extremely rapid and difficult to ascend. Mr. McConnel then proceeded up the Findlay River."

"Whites had been up the Onimeca River previous to him, as at one time that was a famous gold country, but Mr. McConnel and his party were the first whites to ever ascend the Findlay River to its head. The river is about 250 miles long and is navigable for the greater portion of the way in canoes, though owing to the rapids the party had to proceed the last fifty miles on foot, an arduous proceeding, owing to the roughness of the country. The country is very mountainous, and though at the lower part of the river the valley is six miles wide, the mountains come right down to the water's edge in the upper portion."

"At its mouth the Findlay is about as wide as the Frazer at Quesnelle. It is not deep except in the cañons, where the current is very strong, and, owing to numerous rapids and eddies, progress is very slow. At the head of Findlay River is a lake known in the Indian

tongue as Lake Fehutade, which, being interpreted, means "narrow waters between mountains." This lake is the real source of the Mackenzie River. It is between twenty-five and thirty miles long and not more than a quarter of a mile wide, and is enclosed by high mountains. Around the edge of the lake are glaciers, and the scene is a very pretty one. The mountains rise 5000 to 6000 feet above the lake, while they are some 9000 feet above the level of the sea. After exploring the lake Mr. McConnel started on his homeward journey about the end of August, and it was none to soon, as ice began to form on the river, and while on the Parsnip the party experienced a snowstorm."

Mo: Bot. Garden,
1895.

GEOLOGY AND PALEONTOLOGY.

A Food Habit of the Plesiosaurs.—Mr. S. W Williston reports finding a number of pebbles in such a position with respect to the bones of a Plesiosaur discovered in the Niobrara chalk in Kansas that the conclusion is irresistible that the stones had been in the stomach of the reptile. They had probably been swallowed to aid in digestion, a custom still in vogue among the Crocodiles. Some of the pebbles were attached by the original soft limestone matrix to the ribs and thoracic vertebræ, so that there could not be a shadow of a doubt as to the contemporaneity of deposition.

The saurian is one of the largest of the order, measuring when alive about fifty feet. The pebbles, 125 in number, are extremely hard, consisting almost wholly of silica, varying in weight from 1 to 170 grams. They are conspicuous in color, either white, black or pink, and show a great amount of abrasion, and probably came from the shores of the Benton sea.

From the uniformity of shape among the smaller ones, their number, and their color, Mr. Williston is inclined to think they were not merely water-worn pebbles, accidentally swallowed, but they had been selected by the saurian for a purpose, and that their present shape is owing to their prolonged use as "gizzard stones" in the animal's stomach. (Trans. Kansas Acad. Sci., Vol. XIII, 1891-92.)

The Texas Region.—In a recent paper on the physical geography of Texas, R. S. Tarr embodies the results of his personal observation with the published geological work of others in the same region and summarizes the geological history of Texas as follows:

"The evolution of the Texas region began with an old Paleozoic or Pre-Paleozoic mountainous land which was denuded at the beginning of Carboniferous times to an old topographic form, not unlike the hilly region of southern New England. The Carboniferous beds were added to this land, by elevation, first as a costal strip, even before the end of the Carboniferous. A gathering in of shore lines formed a great interior sea, later a completely land-locked dead sea in which Permian beds were deposited; and from the close of the Permian to the beginning of the Cretaceous there was a period of denudation during which the younger Paleozoic beds were reduced to base-level and the older mountainous areas still farther degraded. A rapid subsidence lowered

the entire region below the Cretaceous sea; then at the close of the Cretaceous the land was elevated, possibly by the renewal of the mountain-building forces of the central area. The Rocky Mountain uplift caused an uptilting, raising the land still higher, and adding the Tertiary coastal strip to the Cretaceous. A later uplift added the costal prairies and a recent slight subsidence has completed this record of change, and has given us the Texas region." (Proceeds. Phila. Acad., 1893.)

Terrestrial Submergence Southeast of the American Continent.—At the meeting of the American Association for the Advancement of Science, Madison, 1893, Dr. J. W. Spencer brought before the Society evidence of epeirogenic movements in the Antillean region, in very recent geologic times, amounting to two and one half miles of vertical subsidence of great land areas. The author's recent studies of valleys among the southern Appalachian mountains convinces him that these valleys are independent of mountain movements, and are due to erosion, either atmospheric or by running water. The valleys and channels among the Greater Antilles, and between them and the continent, are an exact reproduction of the southern Appalachian land valleys. From this analogy the author concludes that both the land and submerged Antillean valleys were of a common subaerial origin.

The submerged valleys and channels are of varying depths, the author cites examples ranging from 3,738 feet to 14,000 feet, and even in one case 20,000 feet is reached. The submergence indicated by the channels means extensive continental land-movements, which were not violent enough to obliterate the former land topography. This great continental depression diminished to the north, so that the southern states have been only partly submerged.

The great continental extension was during late Cenozoic time, if McGee's determination of the age of the Lafayette formation be accepted. The drainage of this area was largely into the Pacific, or its embayments. The watershed between the Atlantic and Pacific is still represented by the mountains of Cuba, Haiti and the Windward islands. (Bull. Geol. Soc. Am., Vol. 5, Nov., 1893.)

Tropical Miocene Fossils in Siberia.—A small collection of fossils collected by Dr. William Stimpson in northern Siberia, about 62° north latitude, on an arm of the Okhotsk sea, has been reported upon by Dr. Wm. H. Dall. The collection comprises six species of molluscs, of which five are new. In his general conclusions the author

remarks that "formally the species point to a distinct analogy with those of the China and Japan seas, and like the existing fauna of those seas, they indicate bonds of relationship with the west coast of Africa and the coast of Australia."

The matrix of the fossils determines them to be of Miocene age, and as the fauna indicated by them lived in waters as warm as the Japan sea, the annual mean temperature of the Okhotsh sea in the era in which these fossils flourished must have been about 60° F., a difference of 30° to 40° F. from that of the present time. (Proceeds. U. S. Natl. Mus., Vol. XVI., 1893.)

Arctic Geology.—According to Sir Henry Howorth the Arctic lands, during the Pleistocene period, instead of being overwhelmed by a glacial climate, were under comparatively mild conditions. Since Plistocene times the climate has been growing more and more severe. The author bases this conclusion on a study of the Arctic flora as displayed in Greenland, Spitzbergen, and the uncovered moraine of the great glacier in Alaska, and also upon certain faunal facts. He cites evidence to show that the present flora of Greenland is undoubtedly a relic of an old flora which has survived in favorable localities, and not an importation since Glacial times. The same is true of the Spitzbergen flora. The discovery of a colony of sea-cows on Behring's Island seems to indicate a recently milder climate in that region. The peculiar types of northern migratory birds suggests that at no very remote period they lived the year round in their present breeding places in Northern Siberia, Greenland and Spitzbergen, and that it is the present ever increasing cold that leads them to migrate in search of warmth and food. In short, the only Glacial climate we are warranted in supposing to exist in the Arctic lands is that which is now current, and it is the product of changes in the level of the earth's crust since Plistocene times. (Geol. Mag., Nov., 1893.)

An Extinct Lemuroid from Madagascar.—At a recent meeting of the Royal Society of London Dr. Henry Woodward read a communication from Mr. Forsyth Major concerning a huge fossil Lemuroid from Madagascar, to which we referred in the Nov. number of the NATURALIST (p. 1002). The following report is given in *Nature*, July 20, 1893.

"It is now forty-two years since Geoffroy Ste-Hilaire announced to the French Academy of Science the discovery of gigantic eggs and a few bones of Æpyornis from superficial deposits in the Island of

Madagascar, anticipating that a rich fauna of extinct vertebrata would be speedily forthcoming. Little has, however, been added to our knowledge since 1851 to the present time. In addition to the remains of a Crocodile, two Chelonians, and a Hippopotamus, first discovered by Grandidier, the number of distinct forms of Æpyornis is now rapidly increasing, and promises to rival in variety the New Zealand species of Dinornis, whilst the disclosure of a rich mammalian fauna seems only waiting to reward the carrying out of systematic exploration.

"Four collections of sub-fossil vertebrates, from various regions of Madagascar, have recently been acquired by the British Museum of Natural History. Amongst one of these sent over by Mr. J. T. Last is a somewhat imperfect skull of strange appearance obtained with numerous fragmentary Chelonian, Crocodilian, Hippopotamus and Æpyornis, remains from a marsh at Ambolisatra on the southwest coast of Madagascar. For this remarkable fossil Dr. Major proposes the name *Megaladapis madagascariensis*, and the establishment of a distinct family of the sub-order Lemuroidea, of which Megaladapis appears to be a much specialized gigantic member, being approximately three times the size of the cranium of the largest existing Lemurid.

"The salient features of the skull are the enormous lateral development of the anterior inter-orbital portion of the frontals, extending over the small, thick-walled tubular orbits. The post-orbital frontal region is comparatively narrow and elongate, and separated by a slight contraction from the equally narrow parietal region, bearing a thick and flattened sagittal crest. The brain-case is low, short and narrow, and placed at a considerable higher level than the elongate facial portion. Both the cranial and facial portion are somewhat bent upwards, the former posteriorly, the latter anteriorly. A striking general character is the remarkable pachyostosis (thickening) of the cranium.

"The author points out that, in its peculiar features, this skull only carries to an extreme, characters which are present, but in a much lesser degree, and in varying gradations, in the different members of the Lemuroidea, both recent Lemuridae, and extinct Adapidae. In the very simple pattern of the molars, the superior of which are of the pure tritubercular type, Megaladapis approaches closely to the Malagasy Lemurides, Lepidolemur, and still more to Chirogaleus.

"The diminutive size of the brain-case (comparable only with what we find amongst the Marsupialia and the Insectivora) is viewed by the author, in this instance, as a degeneracy, other characters being equally indicative of a retrogressive evolution undergone by this Lemuroid.

"It is strongly insisted upon, generally, that 'low' organization in Mammalia is by no means always synonymous with 'primitive' organization, and that retrogressive evolution is more frequently to be to be met with amongst Mammalia than is generally admitted.

"As regards the geological age of Megaladapis and its associated fauna, one of whose members the *Crocodilus robustus*, is still living in the lakes of the interior, evidences of various kinds goes far to prove that these sub-fossil remains represent a fauna which was living at a comparatively very recent period, and that man himself was contemporary with it, and in part responsible for its destruction.

"The author adduced evidence in support of the proposition that an older Tertiary vertebrate fauna will ere long be forthcoming in Madagascar."

Geological News. General.—In a brief report on the organic remains obtained from a deep well near Galveston, Texas, Mr. G. D. Harris compares the fossil shells wlth the recent ones of the Atlantic and Pacific shores of America and the fossil faunæ of the Atlantic slope, including that of the West Indies. The relationships are shown in a bathymetric table. The collection comprises 77 species, of which 20 are new. In addition to the marine forms enumerated in the table, the following fresh water species were obtained: *Polygyra hindsii* Pfr., *Amnicola*, not distinguishable from *peracuta*, and a *Planorbis* allied to *P. vermicularis* from the Lake of the Woods. (Fourth Ann. Rept., 1892, Geol. Surv., Texas.)

Paleozoic.—A new gasteropod, *Loxonema winnipegense* from the Trenton limestone of Manitoba is described and figured by Mr. J. F. Whiteaves. The author considers it of interest on account of its strikingly close similarity to some of the most typical Jurassic species of Pseudomelaniæ. (Canadian Rec. Sci., 1893.)

In regard to the use of the term "Catskill," Mr. J. J. Stevenson avers that, in nine-tenths of the area in which this series is exposed within the Appalachian Basin, the Chemung is the important portion of the series. Catskill is simply epochal but "Chemung" carries with it the conception of those physical and biological characteristics which mark the closing period of the Devonian. For which reasons, Chemung should be used to designate the whole group, retaining Catskill in its original and local signification only. (Amer. Journ. Sci., Nov., 1893.)

Mesozoic.—In a contribution to the "Invertebrate Paleontology of the Texas Cretaceous," Mr. F. W. Cragin describes 168 species dis-

tributed as follows: Cœlenterata, 1 sp. nov.; Echinodermata, 32, of which 17 are new; Molluscoidea, 2 sp. nov.; Brachiopoda, 1 sp. nov.; Mollusca, 132, of which 82 are new. The text is illustrated by 46 plates of drawings, some of which were made by the writer. (Fourth Annual Rept., 1892, Geol. Surv., Texas.)

The discovery of fossil Cretaceous plants at Glen Cove, and various other localities in Long Island, by Mr. Arthur Hollick, together with the collections made by Mr. David White in Gardiners Island, Block Island, Center Island and Marthas Vineyard, have enabled Mr. Hollick to trace the continuity of the cretaceous strata from New Jersey through Staten and Long Islands to Marthas Vineyard, and to demonstrate beyond question that the theory of Mather and subsequent observers in regard to the eastward extension of the cretaceous formation was correct, and emphasizes the probability that certain limited areas of the New England coast could also be referred to that horizon. (Trans. New York Acad. Sci., Vol. XII, 1893.)

Two new forms of the Pycnodont genus Anomœdus, *A. superbus* and *A. willetti* from the upper English Cretaceous are described by A. Smith Woodward. This genus was described by Forir, but his definition was based solely upon the arrangement of the splenial teeth. The new material enables Woodward to make the definition more satisfactory. In the same paper the author describes the splenial dentition of two new species of Cœlodus, *C. inaequidens* and *C. fimbriatus.* (Geol. Mag., Nov., 1893.)

In some notes on a few fossil leaves from the Fort Union group of Montana, Mr. F. H. Knowlton describes a new species, *Populus meedsii*, evidently related to *P. heerii* Sap. from the Eocene at Florissant, Colorado, and which has for a living analogue *P. angustifolia* James, a species living along streams from New Mexico and Colorado to California and Washington. (Proceeds. U. S. Natl. Mus., Vol. XVI, 1893.)

Cenozoic.—In a study of the rocks of Carmelo Bay, California, Mr. A. C. Lawson finds no evidence for Whitney's statement that Miocene rocks are here invaded by a mass of granite. The rocks, consisting of sandstone and shales, are probably Eocene, and rest upon a worn and eroded surface of granite. The supposed metamorphic rocks are laminated volcanic flows. Miocene formations are abundantly developed but do not extend down to to the shores of the bay. (Bull. Univ. California, Vol. I, 1893.)

Mr. R. A. F. Penrose records the discovery of a Plistocene manganese deposit near Golconda, Nevada. The ore occurs as a lenticular mass in a soft calcareous tufa, and probably represents a local precipitation from spring waters. The position and nature of the ore show that the bed was laid down in shallow water and subsequently covered over by a tufa deposited from the supersaturated lake water. (Journ. Geol., Vol. I, 1893.)

MINERALOGY AND PETROGRAPHY.[1]

The Granite of Santa Lucia, California, and a New Rock Variety Carmeloite.—The Santa Lucia Mountains[2] in the vicinity of Carmelo Bay, California, consist largely of a porphyritic granite whose phenocrysts of glassy orthoclase are corroded with inclusions of cloudy orthoclase, plagioclase, quartz, biotite, apatite and muscovite, which substances also constitute the groundmass of the rock. The striking feature of the inclusions is that their different areas are not only uniformly orientated with respect to each other, but they are also definitely orientated with reference to their host. They lie in certain definite planes within the phenocrysts, and their crystallographic axes are definitely arranged with respect to the axes of their hosts. The quartzes all lie with their vertical axes nearly perpendicular to the basal plane of the orthoclase, consequently in sections of the phenocrysts cut parallel to the basal pinacoid every included quartz grain exhibits the axial figure. Another feature worthy of notice is the tendency of the inclusions to idiomorphic forms, whereas, the same minerals in the rock's groundmass are always allotriomorphic. The facts of the idiomorphism of the inclusions and their definite orientation suggest to Lawson that these and their hosts are of contemporaneous age. This view is strengthened by the observation that many inclusions on the edges of the phenocysts have grown out into the surrounding matrix, in which, as has already been noted, the components are the same as those occurring as inclusions, but are much larger than these, and are allotriomorphically developed. This granite is cut by dykes of fine-grained aplite.

The rock to which the author has given the name Carmeloite, is a young volcanic, marked by all the characters of a recent lava. It is probably younger than the Monterey series of the Miocene, and older than the newer terrace formations of the region. Under the microscope the rock is seen to consist of phenocrysts of iddingsite, plagioclase and often augite in a matrix composed of a felt of small, lath-shaped plagioclase and granules of magnetite and pyroxene, lying in a glass containing numerons feebly polarizing globulites. There are six areas of the rock in the Carmelo Bay district, the occurrences differing mainly in the quantity of glass present, the presence or absence of

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] A. C. Lawson, Bull. Dept. Geol. Univ. of Cal., Vol. I, p. 1.

iddingsite in the groundmass, and of augite among the phenocrysts. The occurrences differ also in their chemical composition, their silica contents varying between 52.83 % and 60.00 %. The analysis of one specimen (Sp. Gr. = 2.51--2.54).

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	Ign.	Total
60.00	19.01	3.20	.68	tr.	4.10	1.28	2.79	6.97	4.30	= 102.33

Since the rock contains too much SiO_2 for a basalt, and too little for andesite, and because of the prominence of iddingsite as one of its essential components, the author prefers the new name, Carmeloite, to any already in use among petrographers.

The Ancient Rocks of Southern Finland.—In the German resumé of his article on the old rocks of southern Finland, Sederholm[3] divides these into two groups—the Archean and the Algonkian, and the first of these groups into two sub-groups. The older Archean consists of phyllites, gneisses, micaceous and other schists and granular limestone, cut by granite and diorite. All the members of the series have been subjected to dynamic metamorphism on an enormous scale. The schists are supposed to have originated both in sedimentary and in erruptive rocks. The younger Archean schists are phyllites, mica-schists, sandstone-schists, and a greenstone schist that was originally a uralite porphyrite occurring as a surface flow. These are cut by a red granite that is sometimes porphyritic and often pegmatitic. It shows no evidence of having been subject to great pressure, but nevertheless it is foliated—a consequence, according to the author, of flowage. The Algonkian rocks are all fragmental, and above them are the Rapakivi granite and a diabase, both of which are effusive. A younger olivine diabase and a panidiomorphic gabbro are also thought to be volcanic flows.

Petrographical News.—Smith[4] has discovered that the supposed peridotite[5] of Manheim, N. Y., is an alnoite in which there is no pyroxene. It contains a large quantity of melilite in the typical forms, but the mineral is positive in the character of its double refraction, like the artificial melilite made by Vogt. Incidentally the author mentions that positive melilite exists also in the nepheline basalt of Wartenburg, Bohemia, and in the alnoite from Alno, Sweden.

[3] Fennia, 8, No. 3, p. 138.

[4] Amer. Journ. Sci., XLVI, p. 105.

[5] Cp. AMERICAN NATURALIST, Sept., 1892, p. 769.

About 600 miles north of the Falkland Islands in the South Atlantic, a fall of volcanic dust occurred on May 26, 1892. Palache,[6] who has examined some of the material, finds it to consist of fragments of glass and pieces and crystals of orthoclase, plagioclase, green hornblende and magnetite, with a very small quantity of what appears to be pyroxene. The character of the dust is thus andesitic.

New Minerals..—*Iddingsite* has been known for some time as a component of certain eruptive rocks from the far west, but not until Lawson[7] discovered it in the carmeloite of California, had its characteristics been carefully enough investigated to warrant its receiving a name. As described by Lawson, iddingsite occurs as a phenocryst with well-defined crystal outlines. It is of a bronzy color, has a very perfect cleavage and a hardness of 2.5. Its cleavage lamellae are brittle. Before the blow-pipe the mineral is infusible, though it loses water when heated. It is decomposed by acids after long treatment, but loses only its dark pigment, without alteration of its optical properties, when gently heated with hydrochloric acid. Maximum density = 2.839. Its crystals possess in thin section the habit of olivine. If the cleavage is regarded as pinacoidal, the other crystallographic faces are the prism, with a prismatic angle of about 80°, and another pinacoid, both of which are perpendicular to the cleavage. The elongation of the crystals is in the direction of the second pinacoid. If the cleavage is regarded as parallel to the macropinacoid, b is in the cleavage plane, a is at right angles to it, and c is parallel to the elongation of the crystals. The plane of the optical axes is the brachypinacoid, and the mineral is orthorhombic and negative; $a = A$, $b = B$ and $c = C$. In thin section the color varies between yellowish green and chestnut brown, and the absorption is strong parallel to c. The absorption formula is $C > B > A$. The mean index of its fraction is low, and the double refraction strong. Qualitative tests showed the presence of silicon, iron, calcium, magnesium, sodium and water. In spite of the resemblance of its crystals to those of olivine, the author regards it as most probably an original separation from the magma that yielded the carmeloite.

Mackintoshite is the name given by Hidden and Hillebrand[8] to the original material from which the alteration product *thorogummite*[9] is derived. Only a very small quantity was available for study. This is

[6] Amer. Geol., June, 1893, XI, p. 422.
[7] Bull. Dept. Geol. Univ. of Cal., Vol. 1, p. 31.
[8] Amer. Jour. Sci., XLIV, 1890, p. 98.
[9] AMERICAN NATURALIST, Jan., 1893, p. 72.

described as opaque and black. Its hardness is 5.5 and density 5.438. Its crystals are square tetragonal prisms and pyramids like those of zircon. It is infusible before the blow-pipe, and is insoluble in the simple acids. It dissolves readily in a mixture of nitric and sulphuric acid, and in aqua regia. In nine-tenths of a grain of material, the following constituents were found:

SiO_2	UO_2	ZrO_2(?)	ThO_2	$La_2O_3.Y_2O_3$	PbO	FeO	CaO	MgO	K_2O	$(NaLi)_2O$	P_2O_5	H_2O
13.90	22.40	.88	45.30	1.86	3.74	1.15	.59	.10	.42	.68	.67	4.81

The new mineral thus differs from thorogummite in the possession of one molecule of thoria.

Canfieldite is a new germanium mineral from somewhere in Bolivia.[10] Its crystallization is regular, small crystals being bounded by the octahedron and the dodecahedron. The hardness is 2.5, density 6.266, lustre metallic and color black with a purplish tinge. Its streak is grayish black and degree of fusibility 1.5 to 2. Upon analysis, the following result was obtained:

S	Ge	Ag	Fe. Zn.	Ins.		Total
17.04	6.55	76.05	.13	29	=	100.06

which corresponds to the formula $Ag_8\ Ge\ S_6$. A re-analysis of the Freiberg argyrodite yields results that accord better with the formula above-given than with the formula $Ag_6\ Ge\ S_5$ proposed for it by its discover, Winkler.[11] Both minerals have the same composition, consequently, since argyrodite is monoclinic, they are dimorphs.

Marshite.—This copper iodide[12] occurs at Broken Hill, New South Wales, as tiny crystals implanted on a siliceous cerussite. The crystals are probably hemihedral-tetragonal. In color they are reddish-brown, in lustre, resinous. They possess an orange yellow streak, are transparent and brittle.

Kehoeite, from Galena, Lawrence Co., S. D., forms seams and bunches in the galena of the Merritt mine. The material is white, amorphous and insoluble in water. Its analysis yielded Headden[13] the following figures:

P_2O_5	SO_3	ZnO	CaO	Al_2O_3	Fe_2O_3	MgO	Cl	H_2O	Ins.		Total
26.76	.50	11.64	2.70	24.84	.78	.08	tr.	31.06	1.76	=	100.02

[10] S. L. Penfield, Amer. Jour. Sci., XLVI, 1893, p. 101.

[11] Jour. f. prakt. Chem., XXXIV, 1886, p. 177.

[12] C. W. Marsh, Proc. Roy. Sci. N. S. W., XXVI, p. 326.

[13] Amer. Jour. Sci., XLVI, p. 22.

corresponding to $R_3(PO_4)_2+2\ Al_2(PO_4)_2+2\ Al_2(OH)_6+21\ H_2O$.

Neptuneite and *Epididymite* are associated[14] with aegirite, arfvedsonite, eudialyte, etc., near Julianehaab, Kangerdluarsuk, Greenland. The former is found as short, prismatic monoclinic crystals, with a perfect cleavage parallel to ∞P. Their color is black in the larger crystals, but deep red brown in the small ones. Their hardness is 5–6, density, 3.234, and composition:

SiO_2	TiO_2	FeO	MnO	MgO	K_2O	Na_2O	Total
51.53	18.13	10.91	4.97	.49	4.88	9.26	= 100.69

These figures correspond to the formula $(\frac{3}{4}\ Na_2+K_2)\ Si_4O_9+(\frac{2}{3}Fe+\frac{1}{3}\ Mn)\ TiO_3$. Epididymite is regarded as a dimorph of eudidymite. It occurs in orthorhombic prisms elongated in the direction of their macroaxes. Their analysis: $SiO_2 = 73.74$; $BeO = 10.56$ $Na_2O = 12.88$; $H_2O = 3.73$, corresponds to the formula for eudidymite, viz.: $HNa\ Be\ Si_3O_8$. Density $= 2.548$.

Franckeite, from near Chocaya, in the Animas District, Bolivia, is an associate of the silver ores of the region. It occurs,[15] as a radial, aggregate, or as a structureless layer of a dark gray or black substance, that is opaque and soft. Its hardness is about 2.75, and density 5.55. Its quantitative analysis yielded:

Pb	Sn	Sb	S	Fe	Zn	Gangue	Total
50.57	12.34	10.51	21.04	2.48	1.22	.71	= 98.87

while qualitative tests showed it to contain also about .1% of germaniun and a fractional percentage of silver. The mineral is a sulfo-salt of the the formala: $Pb_2\ Sn_2\ S_6 + Pb_2\ Sb_2\ S_6$. It resembles in appearance and in the nature of its components the plumbo-stannite from Moho in Peru, but differs from it in the proportion of its constituents.

Cylindrite owes its name to the cylindrical form that it so commonly assumes. It is described by Frenzel[16] as possessing a dark, lead-gray color and a metallic lustre. It is malleable, has a hardness of 2.5–3, and a density of 5.42. It occurs in cylindrical bodies imbedded irregularly in a granular lamellae mass of the same substance. An analysis of the mineral gave:

Pb	Ag	Fe	Sb	Sn	S	Total
35.41	.62	3.00	8.73	26.37	24.50	= 98.63

[14] G. Flink, Geol. För. Förh., XV, 1893, p. 195.
[15] A. W. Stelzner, Neues Jahrb. f. Min., etc., 1893, II, p. 114.
[16] Ib., 1893, II, p. 125.

corresponding to $Pb_6 Sb_2 Sn_6 S_2$. The mineral is easily decomposed by hot hydrochloric and nitric acid, but is scarcely affected by cold hpdrochloric acid. Like franckeite and plumbostannite, it is a South American mineral, occurring, as it does, at the Mina Santa Cruz, Poopó, Bolivia.

Hantefeuillite accompanies crystals of apatite, pyrite, iron and monazite at the apatite mine at Odegärden, Bamle, Norway. It is found in the greenish nodules composed of wagnerite and apatite, that are scattered through the apatite veins cutting gabbro. Michel[17] describes it as forming transparent, colorless monoclinic crystals radically grouped. Its hardness is 2.5 nnd density 2.435. The crystals are all tabular in habit, being elongated parallel to *c*, and flattened to $\infty P \breve{\infty}$. Their optical axes lie in the latter plane, and their optical angle has a value—2Vna = 54° 23′. An analysis gave P_2O_5 = 34.52; MgO = 25.12; Cao = 5.71; H_2O =34.27, corresponding to $(Mg\ Ca)_3\ (PO_4)_2 + 8H_2O$, which is the guano mineral bobierrite in which Mg has been in part, replaced by Ca.

Chondrostibian, as its name indicates, is an antimony mineral occurring in grains. It is reported by Igelström[18] from the famous manganese mine Sjogrufran, Grythyttan, Sweden. It is found disseminated as grains through barite, which, with calcite and tephroite, forms a cryptio-crystalline mass. These grains constitute nearly 50% of some of the barite plates to which they impart a brownish tinge. The mineral itself is yellowish-red in color, though in large pieces it appears dark brownish red. It is weakly magnetic, and yields, upon analysis, figures indicating the following composition:

Sb_2O_5	As_2O_5	Mn_2O_3	Fe_2O_3	H_2O		Total
30.66	2.10	33.13	15.10	19.01	=	100.00

corresponding to $3R_2O_3\ Sb_2O_5 + 10\ H_2O$.

[17] Bull. d. l. Soc. Franç d. Min., xvi, p. 38.
[18] Zeits. f. Kryst., xxii, p. 43.

BOTANY.[1]

Ellis and Everhart's North American Fungi.—Subscribers to this set have recently received Century XXX of this great distribution of specimens, bringing the number up to 3000. Messrs. Ellis and Everhart are to be congratulated upon having carried their work to this point without a break or serious delay; an achievement never before excelled. May we not hope that they will push forward now toward the fortieth century?

The present volume is a miscellaneous one, including representatives of genera in widely separated families. Thus, there are of *Æcidium* 4 species, *Capnodium* 3, *Cercospora* 11, *Cladosporium* 2, *Cylindrosporium* 3, *Gymnosporangium* 2, *Morchella* 1, *Peronospora* 1, *Peziza* 4, *Phyllosticta* 4, *Puccinia* 7, *Septoria* 6, *Uromyces* 2, besides many others of equally wide relationship.

Of the quality of the specimens nothing need be said. The preceding Centuries have shown that in this regard nothing is wanting. Botanists who are so unfortunate as not to have secured a set of the North American Fungi, will be glad to know that the authors have begun a new set under the name of "Fungi Columbiani," of which they now offer Centuries I and II at six dollars each.—Charles E. Bessey.

A Synopsis of the larger Groups of the Vegetable Kingdom.—The following synopsis represents the results of a careful review of the larger groups of the vegetable kingdom. The Classes are, with few exceptions, those usually recognized by modern authors, but in the first and second their limits have been slightly extended so as to include a comparatively small number of degraded chlorophyll-less forms, the Bacteria and the Phycomycetous fungi.

In like manner, in a few cases, slight changes have been made in the limits of the groups below classes (here tentatively called orders), otherwise they remain essentially as usually outlined. In the attempt to co-ordinate groups it becomes obvious that the "Orders" of the lower plants are equivalent to the "series" of the Angiosperms, according to the nomenclature of Bentham and Hooker's *Genera Plantarum*. At first sight it may seem to be a violent innovation to transfer the term "Order" from *Rosaceæ*, for example, to the great aggregate of forms, the *Calyciforæ*, yet a careful study

[1]Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

of the whole system of plants warrants the assertion that these Benthamian "series" are entitled to no higher rank. The so-called "orders" of the manuals are, in fact, no more than families, and these in the flowering plants have become greatly multiplied.

The apetalous families of Dicoyledons are not regarded as constituting a separate group, but are distributed among the Choripetalæ and Gamopetalæ. In both Monocotyledons and Dicolyledons the apocarpous families are regarded as primitive and lower, and the syncarpous as higher; and among the latter the epigynous are regarded as higher than the hypogynous.

SYNOPSIS.

Branch I. PROTOPHYTA (Protophytes; Water-Slimes).

Single cells, or chains of cells, reproducing by fission and endospores.

Class 1. Schizophyceae. (Fission Algæ.)
- Order Cystiphorae (Blue-green Slimes).
- Order Nematogeneae (Nostocs, Bacteria, etc.).

Branch II. PHYCOPHYTA (Phycophytes; Spore-Tangles).

Single cells, chains, or masses, the latter sometimes forming a branching plant with rhizoids. Sexual reproduction by the union of two protoplasts to form a single resting-spore (zygospore or oöspore).

Class 2. Chlorophyceae. (Green Algæ.)
- Order Protoccoideae (Green-Slimes, Synchytria, etc.).
- Order Conjugatae (Pond-Scums, Black Moulds, etc.).
- Order Siphoniae (Green-Felts, Downy Mildews, etc.).
- Order Confervoideae (Water-Flannels; etc.).

Class 3. Phaeophyceae. (Brown Algæ.)
- Order Phaeosporeae (Kelps).
- Order Dictyoteae.
- Order Fucoideae (Rockweeds).

Branch III. CARPOPHYTA (Carpophytes; Fruit-Tangles).

Chains, plates or masses of cells, the latter often forming a branching plant with rhizoids. Sexual reproduction (where known) by the union of two protoplasts to form a spore-fruit (sporocarp).

Class 4. Coleochaeteae.
- Order Coleochaetaceae (Simple Fruit-Tangles).

Class 5. Ascomycetes. (Sac-Fungi.)
- Order Perisporiaceae (Simple Sac-Fungi).
- Order Tuberoideae (Subterranean Sac-Fungi).
- Order Pyrenomyceteae (Black Fungi, including lichens).
- Order Discomyceteae (Cup Fungi, including lichens).
- Order Uredineae (Rusts).
- Order Ustilagineae (Smuts).

"Imperfect Fungi."
- Order Sphaeropsideae.
- Order Melanconieae.
- Order Hyphomyceteae.

Class 6. Basidiomycetes. (Higher Fungi)
- Order Gasteromyceteae (Puff-balls, etc.).
- Order Hymenomyceteae (Toadstools, etc.).

Class 7. Rhodophyceae.
- Order Florideae (Red Seaweeds).

Class 8. Charophyceae.
- Order Characeae (Stoneworts).

Branch IV. BRYOPHYTA (Bryophytes; Mossworts).

Masses of cells, forming a flat, branching plant with rhizoids, or a leafy stem (oöphyte), reproducing by the union of two protoplasts and the formation of a leafless, spore-bearing stem (sporophyte).

- Class 9. HEPATICAE. (Liverworts.)
  - Order Marchantiaceae (Liverworts, proper).
  - Order Jungermanniaceae (Scale-mosses).
  - Order Anthocerotaceae (Horned Liverworts).
- Class 10. MUSCI. (Mosses.)
  - Order Andreaeaceae.
  - Order Sphagnaceae (Peat Mosses).
  - Order Archidiaceae.
  - Order Bryaceae (True Mosses).

Branch V. PTERIDOPHYTA (Pteridophytes; Fernworts).

Masses of cells, forming a flat plant, usually with rhizoids (oöphyte), reproducing by the union of two protoplasts and the formation of a stem with roots and spore-bearing leaves (sporophyte).

- Class 11. FILICINAE. (Ferns.)
  - Order Ophioglossaceae (Adder-Tongues).
  - Order Marattiaceae (Ringless Ferns).
  - Order Filices (True Ferns).
  - Order Hydropterideae (Pepperworts).
- Class 12. EQUISETINEA.
  - Order Equisetaceae (Joint-rushes; Horsetails).
- Class 13. LYCOPODINAE. (Lycopods.)
  - Order Lycopodiaceae (Club-mosses).
  - Order Selaginelleae (Little Club-mosses).
  - Order Isoetaceae (Quillworts).

Branch VI. ANTHOPHYTA (Anthophytes; Flowering Plants).

Oöphyte small, few-celled, enclosed in the tissue of the sporophyte; reproducing by the union of two protoplasts and the formation of a sporophyte consisting of a stem with roots and spore-bearing leaves, the latter constituting the "flower."

- Class 14. GYMNOSPERMAE. (Gymnosperms.)
  - Order Cycadeae (Cycads).
  - Order Coniferae (Conifers).
  - Order Gnetaceae (Joint-Firs).
- Class 15. ANGIOSPERMAE. (Angiosperms.)
  - Sub-Cl. I. *Monocotyledones.* (Monocotyledons.)
    - Order Apocarpae (Water Plantains).
    - Order Coronarieae (Lilies).
    - Order Nudiflorae (Aroids).
    - Order Calycinae (Palms).
    - Order Glumaceae (Grasses and Sedges)
    - Order Hydrales (Waterworts).
    - Order Epigynae (Irids).
    - Order Microspermae (Orchids).
  - Sub-Cl. II. *Dictyledones.* (Dicotyledons.)
    - i. Choripetalae.
      - Order Thalamiflorae (Toral Choripetalae; Torals).
      - Order Disciflorae (Discal Choripetalae; Discals).
      - Order Calyciflorae (Calycal Choripetalae; Calycals).
    - ii. Gamopetalae.
      - Order Heteromerae (Heteromeral Gamopetalae; Heteromerals).
      - Order Bicarpellatae (Bicarpal Gamopetalae; Bicarpals).
      - Order Inferae (Inferal Gamopetalae; Inferals).

In the foregoing, the slime moulds (*Mycetozoa*) have been omitted, as there can be but little doubt that they more properly belong to the animal kingdom.—CHARLES E. BESSEY.

ZOOLOGY.

Pteropodus Dallii sp. nov. Type:—One specimen 200 mm. long, San Francisco. Head 3, depth 3. D, XIII, $14\frac{1}{2}$; A, III, $6\frac{1}{2}$.

Dorsal spines moderate, two in head; lower jaw projecting. Three straight, dark crossbands, one from nape across base of pectoral, one from between 6th and 7th dorsal spine toward anus, a half one from 8th to 10th dorsal spine to lateral line, a broader one below soft dorsal. These bars extending onto the dorsal fin. A few small dark spots on base of pectorals and on shoulder; sides of tail more or less mottled. Dark streaks radiating from eye. Maxillary extending beyond eye, about $2\frac{1}{5}$ in head. Eye equals snout, $3\frac{6}{7}$ in head, considerably more than inter-orbital width. Inter-orbital concave, two strong ridges dividing it into a median and two lateral grooves. Pre-orbital narrow, with two flat spine processes. Preopercular spines directed backward. Gill-rakers, about two in orbit. Second anal spine $2\frac{1}{3}$ in head. Maxillary, mandibles and snout naked. Scales mostly cycloid. Peritoneum pale. Lower pectoral rays thick and fleshy.

The single specimen belongs to the collections of the Indiana University. We have taken the liberty to name this species for William Healy Dall of the Smithsonian Institution, who has been intimately identified with west coast zoology for many years.

C. H. Eigenmann & C. H. Beeson.

Changes of Plumage in the Bobolink.—Mr. F. W. Chapman shows in the *Auk*, Nov., 1893, a colored plate illustrating the change of plumage in *Dolichonyx oryzivorus.* According to the author the male bobolink in the course of one year passes through the following phases of plumage. Late in July, when the breeding season is over, the black male undergoes a complete molt and appears in the yellowish plumage of the reed-bird, which closely resembles the plumage of the breeding female. In this costume the birds migrate southward, pausing in the rice fields of our southern states, and apparently continuing their journey to the Campo districts of Brazil. A specimen taken at Corumba, Matto Grosso, Brazil, shows that in the spring, as well as after the breeding season, a complete molt takes place, and the male appears in a suit of black feathers tipped with yellow. As the birds travel southward the yellow tips slowly drop off, the nape, scapula and rump fade, and the bill and feet change respectively from flesh color

to blue black and brownish-black. This is shown in a finely graduated series of intermediates in the American Museum of New York. Birds taken during the summer represent the extreme of faded and abraded plumage.

On Three New Genera of Characinidæ.—The following genera were found by Mr. H. H. Smith in the upper waters of the Jacuhy River in the Brazilian State of Rio Grande do Sul.

ASIPHONICHTHYS. This is Anacyrtus with imperfect lateral line, a few anterior scales only displaying it. The only species is *A. stenopterus* sp. nov., which has the following characters. Scales large, l. l. 42; l. tr. 20. Radii; D 11; A 46; V 9; P 15. Depth 2.66 in length less caudal fin; head in do 3.8. times. Eye 3, equal interorbital space. An obscure postclavicular spot; no basal caudal spot.

CHORIMYCTERUS. This is Characidium with two series of teeth in the lower jaw; the external series, like the premaxillaries, tricuspidate; the posterior series simple. Lateral line complete. *C. tenuis* sp. nov. Scales large, 3—39—2. Radii; D 11; A 9; V 9; P 12. Depth one seventh; head one fifth; eye one third. Silvery, scales with shaded edges.

DIAPOMA. Teeth as in Tetragonopterus. Operculum excavated above and with sub-operculum produced below lateral line and above pectoral fin to an obtuse apex. No gill-rakers on principal limb of first gill arch. Dorsal fin entirely posterior to ventrals. Belly not acute; an adipose fin. Lateral line interrupted. *D. speculiferum* sp. nov. Scales large; 4—37—5. Radii; D. I 9; A. II 29; V 7; P 11. Depth 3.25; head 3.6; eye 3, equal interorbital width. Border of anal concave. Reflection of metallic mercury, especially on the operculum. No spots.—E. D. COPE.

Descriptions of Three New Rodents from California and Oregon.

1. NEOTOMA MONOCHROURA. Sp. nov.

(Type, No. 1739, Ad. ♂, Col. Academy Natural Sciences, Phila., Grant's Pass, Josephine Co., Oregon; col. by Geo. Kenzer.)

Description.—Size large, tail long, unicolor, exceeding length of head and body. Above, dark brownish gray, darkest medially, brownest on sides from nose to root of tail; tail uniform blackish brown, thickly and equally clothed above and below with rather short coarse hairs; color of tail never (?) appreciably lighter below than above as often seen in *N. fuscipes;* chin, throat, inside of fore-legs to toes,

inside of hams, belly, vent and feet uniform yellowish white to the bases of hairs; line of demarcation between colors of upper and lower parts well defined; hinder soles, heel and lower outer part of hind leg dusky; ears large, minutely and scantily haired on both sides; whiskers black and nearly twice as long as head.

Measurements (from well stuffed skin).—Total length 460; tail vertebra 216; hind foot 43; ear, from crown 25. Skull, (occipital and pterygoid region missing).—Length from tip of nasals to posterior end of interparietal 50; base of incisor to post-palatal notch 24; greatest anterior width of pterygoid fossa 2.5; distance from post-palatal notch to posterior notch of incisive foramina 10.4; alveolar length of upper molar series 9; greatest zygomatic breadth 27.5; interorbital constriction 6; length of nasals 20; length of mandible, (condyle to anterior point of ramus), 30; width of mandible, (tip of coronoid process to angle), 15.6.

The closest ally of *monochroura* is *fuscipes*, from which it is distinguished by its larger size, pure yellowish white feet and underparts, its longer unicolor tail and dark brown upper parts.

Its cranial differences from *fuscipes* are well marked for the genus They consist in the greater size, greater relative breadth, flat, less convex contour of cranium viewed laterally, greater relative width of molars and the relative narrowness of the pterygoid fossa.

In *monochroura* the ratio of inter-parietal length to breadth is as six to fourteen, in *fuscipes* it is as six to ten; in the former the length of the palatal region from post-palatal notch to incisive foramina is 11 mm., in the latter it averages about 8 mm. In *fuscipes* the post-palatal notch reaches beyond the middle of the last upper molar and the incisive foramina reach back opposite crowns of first upper molars; in *monochroura* the post-palatal notch is opposite the posterior cusp of last molar and the incisive foramina do not reach to the ante-basal line of the upper premolars by 1·5 mm.

The chief differences of dentition may be seen in the upper molar. The coronoid process of *fuscipes* is flattened horizontally above and directed backward, in *monochroura* it is more erect and rounded.

Three specimens of this rat were taken by Mr. Kenzer, who says they often build a very large and conspicuous nest in the sparsely wooded foothills of the Rogue River and Siskyou Mountains. When driven from these nests they betake themselves to the nearest trees with the agility of a squirrel. *N. cinerea occidentalis* was not found in the same region.

2. NEOTOMA INTERMEDIA. Sp. nov.

(Type, No. 1343 ad. ♂ Col. S. N. Rhoads, Dulzura, San Diego Co., Cal., Aug. 21, 1893, Col. by C. H. Marsh).

Description.—Size small, tail slender, short and distinctly bicolor, ears large. Upper parts light brownish-gray lined with black, not darker medially; chin, middle of breast, vent, inside of hind legs, lower two thirds of tail, pes and manus white; rest of under parts, soiled grayish buff, brownest across middle and on sides; bases of hairs darkest; upper third of tail sooty blackish; soles naked, sparsely haired at heel.

Measurements.—Total length 318; tail vertebræ 160; hind foot 35; ear from crown 28; (average measure of 4 adults, length 310; tail 155; foot 34; ear 28). Skull.—Basilar length 33; total length 42; greatest breadth 22; interorbital constriction 5.5; length of nasals 16; interparietal breadth 11.5; length 5.9; length of upper molar series (crown surface), 8; pterygoid fossa to incisive foramina 7.8; length of mandible to upper base of incisor 23.8; height of coronoid process from angle 13.5.

This small, bicolor-tailed Wood Rat from southern California has generally been confounded with *N. mexicana*, but is a different animal, being smaller and larger eared. Its cranial differences are decided. Compared with *mexicana* these are, greater relative size of interparietal, bulging of supraoccipital posteriorly beyond the plane of the occipital condyles, and in the extension of the nasal postero-superior processes of the intermaxillary beyond the base of nasals.

In Dr. Merriam's figure[1] and in Baird's description, these processes terminate opposite the base of nasals, barely reaching the anterior plane of the orbits.

The mandible of *intermedius* is much slenderer and the condyle more prolonged posteriorly, the tip of the latter reaching front of the articular surface of the former.

Seven specimens of this species are in the collection, and I am indebted to Mr. G. S. Miller, Jr., for the loan of others. Mr. Oldfield Thomas described[2] a rat, *N. macrotis*, from San Diego, which, so far as the description goes, must be superficially very like *intermedius*, but it is much larger than any in my series, two of which come from the same locality. The skull measurements of *macrotis* are so applicable to those of *fuscipes* as contrasted with those of *intermedius*, and the colors of the feet and tail in *fuscipes* sufficiently variable to make it pos-

[1]N. Am. Fauna, No. 3, Pl. X. *N. pinetorum*, Proc. Biol. Soc. Wash., 1893, p. 111.
[2]Am. Mag. N. Hist., Sept. 1893, 234.

sible that *macrotis* is a specimen of *fuscipes* with faintly clouded feet and bicolor tail. These considerations induce me to run the risk of imposing a synonym. Two specimens, one from Banning, another from San Bernardino, Cal., seem to represent a pallid race of *intermedius*, differing from the Dulzura Mountain form in the ashy cast of upper parts and the absence of fulvous on the sides and belly, the hairs of chin, breast and ventral region being white to their bases. The skulls of these light colored specimens show their specific identity with *intermedius*. In the involved state of the case as it now stands, I would refer to this race provisionally as *Neotoma intermedia gilva.*

DIPODOMYS PARVUS. Sp. nov.

(Type, No. 1213 ad. ♀, Col. S. N. Rhoads, San Bernardino, California, June 12, 1892, Col. by R. B. Herron).

Description.—Similar to *D. merriami*, but smaller-bodied, longer-tailed and lacking the black on sides of nose and face. Above, buffy gray, becoming purer buff on sides. Spot at base of ear, fringe over eye, sides of nose, (except base of whiskers), forepart of cheeks, forelegs, inside of hind legs, feet, sides of tail, stripe across thighs and under parts white, strongly defined laterally against color of upper parts. Upper and lower fourth of crested penicillate tail, brownish-black, pencil sooty brown; plantar surface of hind feet brownish; narrow ring around eyes, black.

Measurements.—Total length 248; tail vertebræ 154; hind foot 35; ear (from skin) 10; pencil 25. Skull.—Basilar length 21; mastoid breadth 22.5; interorbital constriction 13; length of nasals 13; crown length of upper molar series 3.6; width of foramen magnum 5; tip of nasals to interparietal 28.4, to extremity of ante-orbital process of maxillary 18.9; greatest ante-orbital width (molar) 20; length of mandible 13.9; height of coronoid process from angle 5.1.

Six specimens represent this species in my collection; three are adult; all were taken in the San Bernardino Valley. The average measurements of adults are somewhat less than those given above. The type is more fulvous than any of the series. Spring specimens are grayer (less fulvous) than type and the tail brush is sooty.

No skull characters or measurements being given for *merriami* by Dr. Mearns, it is impossible to make cranial comparisons with that species.

Compared with *D. similis*[3] and *D. simiolus*[3], *D. parvus* is readily distinguished by its darker, grayer colors. Its skull differs from either of the former in its shortness, greater relative width and size of brain case.

[3]Proc. Acad. N. Sci., Phila., Nov., 1893.

In *parvus* the ratio of mastoid breadth to greatest ante-orbital jugal breadth is 88.8, in *simiolus* it is 82.6, in *similis* it is 86.8.

Of the two, *parvus* much more nearly resembles *similis* than *simiolus* in cranial characters and it is possible that a fuller series will show *parvus* to be merely a small, dark subspecies of *similis*.

SAMUEL N. RHOADS.

Zoological News, Vermes.—In a recent paper on the *Ocnerodrilus*, Mr. Gustav Eisen gives a detailed description of the anatomical structure of the 10 known species of this genus. All are tropical or semi-tropical in their habitat, and appear to be restricted to the American Continent. According to the author, the systematic position of this genus is a most interesting one, as showing the affinities with both the water and with the land Oligochœta, and bear a close relationship to Beddard's new genus *Gordiodrilus*.

The paper includes a diagnosis and a synoptic arrangements of the species. (Proceeds. Cal. Acad. Sci., Vol. III).

Mollusca.—A list of the land and marine shells of the Galapagos Islands, compiled by Mr. R. E. C. Stearns, has been published in the Proceeds. U. S. Nat. Mus., Vol. XVI. The list is based on the collection made during the voyage of the Albatross in 1887–88, supplemented by examples contained in the U. S. Nat. Mus. and in other collections from authentic sources. The total number of species is 288, varieties 30, making in all 318, which are segregated as follows. Marine Lamellibranchs 61; Scaphopods 1; Gastropods, marine species 205, with 13 varieties; Gastropods, land species 31, with 17 varieties.

Pisces.—A new shark, *Centrina bruniensis*, from the Tasmanian Coast, and a new species of pelagic fish *Centrolophus maoricus*, from New Zealand, are described by Mr. J. D. Ogilby in the Records of the Australian Museum, Sept., 1893. The latter, according to the author. is quite as interesting a discovery as that of Tetragonurus some years ago at Lord Howe Island, and bears a close analogy to it, both genera being Mediterranean types.

A new Cyprinoid fish, *Couesius greenii* from the headwaters of Frazer River, B. C., is described by Dr. D. S. Jordan. The species is related to *Couesius plumbeus* of the upper Missouri and Lake Superior region, from which species it differs in the larger size of the scales and in some details of form. The head is especially large and heavy. (Proceeds. Nat. Mus., Vol. XVI).

Reptilia.—Mr. Edgar R. Waite has commenced an investigation of the Australian Typhlopidæ. In his first paper upon the subject he describes a new species *T. proximus*, notes thas *T. curtus* Ogilby must be referred to *T. ligatus* Peters, and decides that *T. ruppelli*, which is generally considered identical with *T. nigrescens* Gray, has a distinct specific rank. (Records Austr. Mus., Vol. II, No. 5, 1893).

Mammalia.—An experiment recently conducted by a captain of a vessel, assisted by a naturalist who happened to be on board, shows the traction power of a whale 23 meters long, and weighing about 70 tons, to be close to 145 horse power. However under the conditions in which the experiment was performed it is more than probable that the animal did not exert its full strength. The whale might become of use to the man as a working factor, but it can never be depended upon as is the elephant for example.

Among the mammals recently collected by Dr. W. L. Abbott, in the islands north of Madagascar, are two specimens of an interesting new species of *Pteropus* from Aldabra Island. They are described by Mr. F. W. True in the Proceeds. Nat. Mus., Vol. XVI, under the name *Pteropus aldabrensis*.

New Mammals.—In the fifth volume of the Bulletin of American Mus. Nat. Hist. are from papers dealing with new or little known mammals. Mr. J. A. Allen describes *Didelphys* (*Micoureus*) *canescens* from Tehuantepec, *Oryzomys costaricineis* from Costa Rica. Mr. Frank M. Chapman describes *Oryzomys palustris natator* from North Carolina and Florida. In a paper by both gentlemen an account is given of a collection of mammals from Trinidad. 65 species are enumerated as constituting the fauna of the island, of which the following are new:—*Chœronycteris intermedia, Nectomys planipes, Tylomys couesii, Oryzomys speciosus, O. trinitatis, O. velutinus, O. brevicauda, Loncheres castaneus* and *Echimys trinitatis.*

EMBRYOLOGY.[1]

Embryology of Sponges.[2]—Mons. Yves Delage in an interesting paper describes discoveries, the acceptance of which implies the overthrow of our present ideas of sponge morphology. The post-larval development of three silicious sponges, Spongilla, Esperella, Reniera and of a horny sporge, Aplysilla, was followed, and it was found that in the essential features of development all the forms agreed.

Larva.—The larva in all four sponges is a solid larva, the superficial layer of which is composed of slender ciliated cells. The inner one contains, except in Aplysilla, three distinct kinds of cells, each kind destined to form a particular part of the adult body. Just beneath or scattered between the basal parts of the superficial elements, is a discontinuous layer of rounded or irregular cells, which the author claims form the definitive epidermis, and which he, therefore calls epidermic cells. Internal to this layer is a mass composed of amœboid and "intermediary" cells, the former characterized as well by the nucleus as by the power of throwing out pseudopodia, while the latter are immobile cells of rather a negative nature. In the Aplysilla larva the two latter classes cannot be distinguished.

While in Spongilla the ciliated cells form a continuous covering for the larva, in the larvæ of the three other sporges they are absent over one of the poles, posterior in Esperella and Reniera, anterior in Aplysilla. Here the epidermic cells lie at the surface. (Against this interpretation of the cells covering the non-ciliated pole may be urged the observations of the reviewer on Esperella and Tedania, in which sponges it was found that the cells in question and the ciliated cells of the larva are differentiated portions of an external homogenous layer, representing the ectoderm of the embryo.[3])

The large cavity which, as is well known, occupies the anterior portion of the Spongilla larva has, according to the author, no morphological significance. It is only a magnified lacuna, such as is found here

[1]Edited by E. A. Andrews Baltimore Md: to whom contributions may be addressed.

[2] Embryogénie des Eponges. Yves Delage. Archives de Zoologie Expérimentale et Génerale. Année, 1892. No. 3.

[3] Notes on the Development of Some Sponges. Journal of Morphology. Vol. V, No. 3, 1891.

and there in the inner mass of all solid sponge larvæ, and disappears during metamorphosis. It is probably concerned in maintaining the equilibrium of the larva.

Metamorphosis.—It is commonly believed that the ciliated cells of the larva flatten and become the epidermis of the adult, but Delage finds that the former absorb their cilia, assume a rounded shape and migrate into the interior, their place being taken by the epidermic cells which fuse with one another so as to form a complete membrane. Only over the non-ciliated pole of the larva does this inter-change of cells fail to take place, for here the epidermic cells have all along been at the surface.

The ciliated cells that migrate into the interior are destined to become the collared cells of the flagellated chambers. The interval between their immigration and the formation of the chambers is marked by a curious association of these cells with the amœboids. The latter elements engulf, amœba-fashion, the former. Complete fusion takes place between the bodies of the amœboid and the absorbed cells, but the nuclei of the latter remain distinct, and range themselves round the larger nucleus of the amœboid. (Multinucleate cells, whether formed in this way or not, undoubtedly exist in the developing sponge. They were observed by Götte (1888) who regarded the smaller bodies contained in them and arranged round the larger central one, as deuto-plastic structures, which become nuclei. Moss (1890) regards the small peripheral bodies simply as deutoplastic structures. Wilson (1891) describes them as nuclei). In Spongilla all the ciliated are so absorbed. In the other sponges only a portion are so absorbed. The rest unite with one another and with the (now) multinucleate amœboids to form a syncitium. To form a flagellated chamber several multinucleate masses approach one another so as to surround a central space, the cavity of the future chamber. The nuclei of the absorbed (ciliated) cells arrange themselves round this cavity and cell bodies are differentiated about them, while the nucleus of the original amœboid cell, surrounded by protoplasm, escapes from the anlage of the chamber, and becomes one of the wandering cells of the adult mesoderm (the reviewer, l. c., has shown that chambers are sometimes formed by the fusion of multinucleate masses, but has also shown that chambers may be simultaneously formed by aggregations of amœboid or "formative" cells, which may or may not be multinucleate. The two processes are regarded as fundamentally the same. Such observations would seem to contradict the author's thesis that it is the immigrated ciliated cells which form the

chambers). The remaining ciliated cells forming the syncytium, unite in a similar manner and build up flagellated chambers.

The chambers are thus formed independently of any central space. The canals are likewise formed independently of each other, as so many irregular spaces, which gradually become lined with an epithelium consisting of "intermediary" cells, the remaining "intermediary" cells becoming the stationary elements of the adult mesoderm. The union into a connected system, of chambers and canals, with the formation of pores and oscula complete the development.

The conclusions enunciated in this paper as to the origin of the canal epithelium and the collared cells of the chambers differ from those presented in the author's previous notes on sponge embryology (Comptes Rendus, 1890, 1891), though the account of the formation of the adult epidermis remains the same. On these points the paper is nearly in harmony with the recent contribution of Maas on the metamorphosis of Esperia (1892), though Maas derives both canal epithelium and collared cells from immigrated ciliated cells. The weight attaching to this harmony of observation on the development of Esperella, is however, lessened by the direct contradiction in the accounts, given by these two authors, of the Spongilla development. In the latter sponge, which according to Delage agrees with Esperella, Maas (1890) has described and figured in a most detailed way the transformation of the larval ciliated cells into the flattened definitive epidermis.

Germs Layers.—As the author points out, his discoveries make it extremely difficult to draw a comparison between the germ layers of the sponges and those of other Metazoa. The case of Sycandra he thinks already constituted a serious difficulty. In this he adopts the point of view of Balfour, and is accordingly perplexed to find granular cells, such as in other larvæ constitute the entoderm, here forming the adult epidermis, while the ciliated cells invaginate to form the epithelium of the paragastric cavity. But the difficulty reaches its height when he attempts to compare the larva of Spongilla with that of other animals. This larva is covered on the outside by cells, which eventually form the epithelium of the flagellated chambers. While the cells which will constitute the adult epidermis are in the larva situated in the interior, i. e. beneath the surface layer of ciliated cells. These facts place us in a dilemma. Accepting the ordinary views on the structure of the sponge body, we would call the epidermis of the adult, ectoderm, and the epithelium of the flagellated chambers, entoderm. Adopting this position, we reach on turning to the larva of Spongilla, the strange conclusion that the swimming larva is covered with a layer of entoderm,

while the ectoderm is internal! If, discouraged at this result, we decide to regard the germ layers as occupying the same relative position in the Spongilla larva as in the larvæ of other Metozoa, and therefore call the superficial layer of ciliated cells ectoderm, and the inner mass of cells entoderm, we reach the equally strange conclusion that the adult epidermis is composed of entoderm, while the lining epithelium of the flagellated chambers is formed of ectoderm! The only way out of the dilemma is to regard the sponges as a phylum which has followed from the start a path of development distinct from that of Cœlenterates and other Metazoa. This being so, a comparison of layers is impossible.

H. V. Wilson.

Development of the Newt.—Edwin Oakes Jordan[3] presented for the Ph. D. degree at Clark University a study of the common newt *Diemyctylus viridescens* Raf., that contains a very clear account of the maturation of the ovum, fertilization, cleavage, and formation and fate of the blastopore in addition to many new facts in the breeding habits of this interesting amphibian.

The "yolk nuclei" are considered at some length and regarded as "having a real physiological significance, probably related to the construction of yolk." In this formation of yolk there is "nothing to indicate that the yolk spherules increase by division, everything on the contrary indicates that they arise from points of independant origin."

The nucleoli in the egg nucleus are described in their formation and disintegration and the idea advanced that they may be but enlargments of the minute granules making up the chromatin threads. Regarding the nucleoli as of nutritive function, acting during the anabolic period of maturation, the author would suggest that they might be compared with the macronucleus of an infusorian.

In the formation of the polar bodies there is an accumulation of pigment at the pole of the spindle suggesting the presence of a centrosome, but none could be found. Much in the same way the entering sperm, in fertilization seems to exhibit an attractive influence over the pigment granules. Elsewhere, however in speaking of the gastrula, the author supposes that pigmentation of the cells is a mark of physiological activity; so that we are left in doubt as to how for an apparent attraction of pigment may be a new formation of it.

In the account of the process of fertilzation we learn that there is no fixed and predetermined point of entrance of sperm and moreover several may, in fact normally do, enter one ovum without in any way causing abnormal development.

[3]Journal of Morphology. VIII. 1893.

The reader of this chapter will notice how easy it is to extend ones anthropomorphism even to unclei!

The noticeable fact brought out in studying the cleavage is that it is very irregular and variable in normal eggs. Even the third plane that we expect to find horizontal may be so only in a small part of its extent or, more often, quite vertical. These points will be considered in another paper by the author and Mr. Eccleshymer.

The long axis of the animal is found to develope at right angles to the first cleavage plane: not agreeing with what seems the rule in the frog. This first plane cuts the egg at right angles to its elongation, (it is elongated by pressure in the oviduct) and this invariable rule is, the author holds, the result of that pressure, the first spindle being able to place itself more readily in the one direction than in any other. He thus adopts, provisionally, a mechanical explanation of the determination of the first cleavage plane in the newts' eggs.

In the vexed subject of gastrulation the author's position is that invagination, to some extent, does actually occur. Epiboly can be actually seen in living eggs "the small cells roll down over the others (epibolic invagination), and at the same time the cells around the edge of the blastoderm turn in and dissappear from view (embolic invagination?)"

The blastoderm closes in first from all sides equally then, usually, more rapidly and equally from the right and left side, but sometimes from behind forward more rapidly, occasionally, perhaps, from before backword more rapidly.

A slit is thus formed, which at first opens into the archenteron along its whole length but soon closes, except its anterior end, the evanescent neuropore, and its posterior end the definitive anus.

The author restricts the term primitive streak to the liner fusion of the germ layers.

The conspicuous ectodermal furrow, "neural groove," is thus no part of the primitive streak: it may be merely a result of mechanical stresses.

The mesoblast is figured as presenting, in some cases, most marked lateral pouches at the anterior end of the embryo.

Amphioxus.—Prof. E. B. Wilson[4] has published a fully illustrated account of the most important experimental work upon the eggs of Amphioxus mentioned in the January NATURALIST.

Animal eggs show three chief types of cleavage the radial, the

[4]Journal of Morphology. VIII. August 1893.

spiral and the bilateral. In Amphioxus individual eggs are found that conform to each of these types; other intermediate methods are also observed. All these normal modes of clecvage are figured and described with great clearness.

Any attempt to draw a close comparison between the cleavage of Amphioxus and that of the Annelids must fail. The tempting pole cells that the text books have inherited from Hatschek's account cannot be found: "the pole cells of Amphioxus are a myth."

By the method of Driesch the cleavage cells may be isolated and the subsequent cleavage of these studied. Many important facts result of which but a few may be referred to here.

One of the first two cells, completely isolated, may cleave like an egg, form a blastula, gastrula and even larva of the one gill-slit stage, all perfect but of half the normal size. If the cell is not completely isolated from its fellow but merely displaced it will develope more or less separate from its fellow so that all sorts of twins or more or less completely doubled, embryos, blastulas, gastrulas and larvæ result. Here it is of great import to note that the first cleavage of the displaced cells determines the axial relations of the resulting double monsters. "*Even a slight displacement of blastomers in the two-celled stage causes a change in the form of cleavage, such that the blastomers of the half embryo cannot be identified individually with those of a normal embryo half. The normal embryo develops as a unit; if it be disturbed in the two celled stage, this unity is destroyed and two new units established.*"

Moreover it would seem that "the unity of the normal embryo is not caused by a mere juxtoposition of the cells," . . . . "this unity is not mechanical but physiological" . . . . "there must be a structural continuity from cell to cell that is the medium of coordination and that is broken by mechanical displacements of blastmeres."

Returning again to the actual observations. One of the first four cells when isolated may cleave like a whole egg, may form a perfect blastula, gastrula, larva of one fourth the normal size. If the cells of the four-cell stage are not completely isolated various double, triple and quadruple blastulas may arise.

The isolated cell of the eight-cell stage may cleave in a way much like a whole egg but not identical with it. Rarely a blastula may result, one of one eight the normal size.

The author then applies all these observations to the questions of regeneration and the Mosaic Theory of Development. He takes a somewhat middle or combination position between the views of Driesch

and Hertwig on the one hand and of Roux and Weismann on the other.

Roux and Weismann hold that histological differentiation is due to *qualitative* divisions of the idioplasm in successive mitotic cell cleavages and that the embryo is thus a mosaic of self-determining cells: moreover they assume that each cell may also receive *quantitatively* some unmodified idioplasm that remains dormant till called into activity by injury, etc., when regeneration of lost parts is to be accomplished. All this Wilson rejects: retaining, however, a modified form of the mosaic theory, believing that this principal does come in after the earlier stages of cleavage and at very different periods in different animals (the differentiation is however a physiclogical one, there being no loss of nor unequal distribution of actual idioplosm in cell divisions).

That the ontogeny is determined by the character of the ovum at the first; these first phenomena determine the subsequent ones; the prospective value of a cell is a function of its position at first but in later stages becomes fixed by internal changes largely due to the action of the whole upon this cell, these are conceptions in which Wilson comes into closer agreement with Driesch and Hertwig.

Experimental Studies on Teleost Eggs.—Dr. T. H Morgan[5] claims some very important and valuable results from an application of the experimental method to the study of early stages in the embryology of the fish, Ctenolabrus, Serranus and Fundulus.

Awaiting the publication of an illustrated paper we can here note but a few of the chief facts presented in this preliminary communication.

If one of the first blastomeres is removed and destroyed the other may develope a normal embryo which is larger than half a normal embryo but not as large as an entire one.

If half or two-thirds of the yolk be removed from the egg the cleavage is modified and the blastoderm has a peculiar shape yet a normal embryo results.

When the blastodisc is compressed so that a flat plate of cells is formed by cleavage there yet results a normal embryo.

If the germ ring be cut upon one side the embryo continues to be formed and is normal. It can also be shown by markimg the membrane with carmine that the head is a fixed point, the elongation of the body being posterier to this. Hence it follows that the germ ring takes no important part in the formation of the embryo and the *concrescence* theory receives a very severe blow.

[5]Anatomischer Anzeiger. VIII. 1893.

Formation of the Annelid Eye.—Our knowledge of the embryonic stages of the eyes of Annelids has been so scanty that the additions made by Ed. Beraneck[6] cannot be but welcome however little claim they may have to being exhaustive.

The author has studied the egg of the Alciopidæ, in the larva and adult and added to what had been previously made known by Kleinenberg and Greef. The eyes in this family of annelids, it will be remembered, rank amongst the most complex and perfect of visual organs and are far larger and more specialized than those of any other annelids. The structure is as follows; the optic vesicle is closed, a single layer of cells acting as cornea on the side next the thin epidermis and as retina elsewhere. Within the vesicle are the dioptric media: a spherical lens next the cornea, a very voluminous vitreus body filling up the large vesicle and subdivided into an outer part towards the retina and a major mass towards the lens, finally the rods that tip the retinal cells and line the vesicle except on the side of the cornea. It is important to note that the eye is a closed vesicle not a cup as has been claimed by Graber and denied by Graff and Carrière. Moreover this vesicle is a single layer of cells, hence the retina is a single layer of cells, each having a long rod pointing towards the centre of the eye. In the adult there are no cells in the eye except those that form the walls of the vesicle: neither lens nor vitreous body presents any signs of cellular origin. The piginet of the retina is in the cells that bear the rods, at the end whence springs the rod.

It is thus obvious that this eye has no resemblance to the arthropod eye: as the author points out in detail.

The formation of the eye is made out from sections of larvæ. The earliest taken, 3 mm. long, living it will be remembered inside a Ctenophore, has already two large masses of cells separate from the ectoderm and crowded on either side of the few brain cells. These masses are the eyes as first observed. Each is a solid mass with numerous nuclei. Of these nuclei the author would distinguish three kinds—the small ones that form the future vesicle: a few large ones that form certain remarkable gland cells, and finally a single cell in each mass destined to form the beginning of the lens.

In a remarkable way this cell by degeneration forms a centre about which products formed by gland cells aggregate till a minute lens is seen surrounded by more liquid substance: the space so hollowed out in the eye is still surrouned by numerous cells that gradually specialize as the cornea and retina.

[6]Revue Suisse de Zoolögie. I. June 1893.

Very early some of these retinal cells form a rod at the free end and afterward isolated grains of pigment appear in these cells, near the rod end. Meantime the few large gland cells, in the retina, instead of forming rods form a secretion poured out between the lens and the retina. The lens grows enormously, has no longer any trace of its cell origin, and is believed to increase, in some way, by aid of the glandular secretion.

The remarkable gland cells that are mentioned above as occuring even in the youngest larva studied may be found in the adult. They have the important function of secreting the vitreous body.

Each eye has one of these peculiar glands (they are not to be compared with minute gland cells seen in the retina) lying outside the wall of the retina though in its origin one of the mass of cells that gave rise to the whole eye.

This gland is a large protoplasmic mass with two large nuclei and often numerous smaller nuclei and leads through the retina into the optic vesicle by a sort of duct or process.

One other point the author has elucidated is the so called ciliary body, which proves to be merely a part of the retina that developes in an isolated position at the edge of the cornea.

It is apparent that as this eye arises quite independently of the brain and, as far as the authors observations go, of the epidermis also little comfort is to be got from it for those who would reduce the Annelid eye to a simple epidermal thickening: they must fall back upon the statement that the ontogeny of this highly specialized eye in an apparently aberant group throws no light upon the phylogeny of the Annelid eye.

ENTOMOLOGY.[1]

Evolution and Taxonomy.—Under this general title Professor J. H. Comstock has published an extremely important and suggestive essay.[2] Starting with the evident proposition that the systematists of to-day are not making as much use of the theory of descent in taxonomic work as they might, the author suggests that "the logical way to go to work to determine the affinities of the members of a group of organisms is first to endeavor to ascertain the structure of the primitive members of this group; and then endeavor to learn in what ways these primitive forms have been modified by natural selection, keeping in mind that in each generation those forms have survived whose parts were best fitted to perform their functions." Some of the difficulties to be encountered in the carrying out of this suggestion are next considered. "As the structure of a highly organized animal or plant is too complicated to be understood in detail at once, it is suggested that the student begin with the study of a single organ possessed by the members of the group to be classified." He is to observe the forms and functions of this organ; and to determine its primitive form and the various ways in which the primitive form has been modified. Then another organ is to be selected and results compared. In this way a provisional classification can be made.

The second part of Professor Comstock's essay considers the evolution of the wings of insects. The method above suggested is here applied to the wings of the Lepidoptera; and is followed by a contribution to the classification of the Lepidoptera which forms the third part of the essay. This classification is a provisional one, but the author confidently expects "that the principal conclusions stated here will be confirmed by a study of other parts of the body; for in Nature's court the testimony of different witnesses, if rightly understood, will agree."

The proposed classification is indicated in the following table:

[1]Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2]Evolution and Taxonomy. An essay on the application of the theory of natural selection in the classification of animals and plants. Illustrated by a study of the evolution of the wings of insects and by a contribution to the classification of the *Lepidoptera.*—Reprinted from the Wilder Quarter-Century Book—Comstock Publishing Co. Ithaca, New York.

A. Suborder JUGATÆ.

B. *The Macrojugatæ* — Family HEPIALIDÆ.

BB. *The Microjugatæ* — Family MICROPTERYGIDÆ.

AA. Suborder FRENATÆ.

B. *The Microfrenatæ.*

C. *The Tineids* — Superfamily TINEINA.

CC. *The Tortricids* — Superfamily TORTRICINA.

CCC. *The Pyralids* — Superfamily PYRALIDINA.

BB. *The Macrofrenatæ.*

C. *The Frenulum-conservers.*

D. Moths in which the reduction of the anal area of the hind wings precedes the reduction of the anal area of the fore wings. No N. American species. *Castnia* an example.

DD. Moths in which the reduction of the anal area of the fore wings precedes the reduction of the anal area of the hind wings.

E. *The Generalized Frenulum-conservers.*

F. Moths in which a great reduction of the sub-costal cell of the hind wings is taking place.

G. Moths in which the anal veins of the fore-wings anastomose so as to appear to be branched outwardly.

Family MEGALOPYGIDÆ.

GG. Moths in which the anal veins do not anastomose in such a way as to appear branched outwardly.

Superfamily ZYGÆINA. (in part)

FF. Moths in which the subcostal cell of the hind wings is not greatly reduced.

G. Moths in which the anal veins of the fore-wings anastomose so as to appear to be branched outwardly.

Family Psychidæ.

GG. Moths in which the anal veins do not anastomose in such a way as to appear branched outwardly.

H. — Family COSSIDÆ.

HH. — Family LIMACODIDÆ.

EE. *The Specialized Frenulum-conservers.*

F. DIOPTIDÆ.

FF. *The Geometro-Bombycids and the Geometridæ.*

Families NOTODONTIDÆ, BREPHIDÆ, GEOMETRIDÆ.

FFF. *The Noctuo-Bombycids and the Noctuids.*

Familes CYMATOPHORIDÆ, NOCTUIDÆ.

LIPARIDÆ, AGARISTIDÆ, and ARCTIIDÆ.

FFFF. *Isolated families of specialized frenulum conservers*

Families SESIIDÆ, THYRIDIDÆ, SPHINGIDÆ, and Superfamily ZYGAEINA.

CC. *The Frenulum-losers.*

D. *The Frenulum-losing Moths.*

Superfamily SATURNIINA and families DREPANIDÆ and LASIOCAMPIDÆ.

DD. THE SKIPPERS.—Butterflies in which all of the branches of radius of the fore wings arise from the discal cell. Family HESPERIDÆ

DDD. *The Butterflies.*—Butterflies in which some of the branches of radius coalesce beyond the apex of the discal cell.

Families PAPILIONIDÆ, PIERIDÆ, LYCÆNIDÆ and NYMPHALIDÆ.

The essay is illustrated by an admirable plate engraved on wood from Nature by Mrs. Comstock and a large number of ink drawings by Mr. E. P. Felt.

Habits of Halobates.—Mr. James J. Walker of the British Royal Navy has recently published[3] an account of his observations on the peculiar bugs of the genus Halobates. He has studied them in many seas for several years, finding the habits of the various species much alike. "In tropical latitudes, when a sailing ship is becalmed, or a steamer is stopped for any purpose on a perfectly calm sea, it is not long before little whitish creatures are seen rapidly swimming over the glassy surface with a sinuous motion, and soon half a dozen or more Halobates are in view at once, evidently attracted by the bulky hull of the ship which they will approach frequently within arm's length. Their progress seems to be effected by a sort of skating action of the long, ciliated, intermediate and hind legs. When the ship is anchored in a current or tide way, they keep abreast of her by a series of short rushes of a foot or so against the stream, giving a

[3]Ent. Month. Mag. 2d. ser. v. IV, p. 227.

speed quite sufficient to stem a current of two or three knots per hour. * * * They seem to like the sunshine and were much scarcer when it was overcast. A heavy swell, provided the weather is quite calm, does not prevent their appearance, but with the ripple caused by the slightest breeze they vanish at once. * * * I have kept the Chinese species alive for several days in a vessel of sea water, at first they are very restless, rushing about and occasionally jumping up two or three inches from the surface, but after a few hours they became much quieter. They then rest on the water with the legs widely extended, and the intermediate pair brought forward so as to have the tarsi in advance of the head. On the approach of a pencil or the finger they dive readily, and swim with great facility beneath the surface, the air entangled in the pubescence giving them a beautiful appearance like that of a globule of mercury or polished silver. This supply of air must be essential to the existence of the insects, which I feel sure must pass a large part of their life beneath the surface of the sea, diving into undisturbed water in rough or even moderate weather, and coming up again only when it is absolutely calm."

Mr. Walker is unable to add anything to our knowledge of the feeding habits of these bugs. "The union of the sexes takes place on the surface of the sea, and the eggs are unquestionably carried about by the female attached to the extremity of the abdomen for some time before she parts with them." Two females of *H. Wulderstorffii* were taken from the Marquesas Islands with eggs thus attached. The eggs are large for the insect, cylindrical with rounded ends, and ochraceous yellow. Where they are finally deposited he did not observe though[4] in a subsequent note attention is called to Witlaczil's record of the finding of a bird's feather at sea covered with the eggs of Halobates.

Pupation of Gyrinus and Dineutes.—Mr. H. F. Wickham continues his studies of the early stages of North American Coleoptera, his latest contribution[5] including descriptions of nine species. He describes the larva of *Gyrinus picipes* as pupating in mud cells without any intermixture of silk. "Probably the larva uses any readily accessible matter in the formation of its cell and when under stones would use mud, while if under bark might utilize wood or bark fibre, thus giving the 'cocoon' a papery consistence." The pupation of *Dineutes assimilis* is described thus: "The larvæ on coming out of the water repair to the under surface of a stone or a board close

[4]lc. p. 252.

[5]Bull. Lab. Nat. Hist. Univ. of Iowa. II, pp. 330—344, pl. IX.

enough to the waters edge to insure continued dampness, and there construct an oval cell of earth, without any admixture of silk so far as I can find. These cells are not simple excavations of earth beneath the stone but are built upon it like the cells of some of our mudwasps, and are not very unlike them in shape."

Hermann August Hagen.—This veteran entomologist, for many years Professor of entomology at Harvard College, died at his home in Cambridge, Nov 9 last. Born in Königsberg, Prussia, May 30, 1817, he graduated in medicine in 1840, and was a practicing physician in Königsburg until 1867. He then, at the invitation of the elder Agassiz, came to Cambridge to become Curator of the entomological department of the Museum of Comparative Zoology, a position which he retained until his death, though because of ill health he has not been actively at work for several years. Dr. Hagen has long been known as an authority in entomology, especially on the Neuroptera and their allies; and by his work at the Museum has greatly helped the development of the science in America.

Entomological Notes.—Professor L. M. Underwood has edited and the U. S. National Museum has published (Bull. 46) the papers on North American Myriopoda written by the late C. H. Bollman. The Bulletin covers more than 200 pages and must form the basis of future work on this neglected group.

At the meeting of the London Entomological Society, Oct. 4, specimens of Lepidoptera which had been exposed in the pupa stage to low temperatures were exhibited by Mr. F. Merrifield. "*Vanessa polychloros* was much darkened, especially toward the hinder margin, by a low temperature. *Vanessa c-album* showed effects on both sides, especially in the female; they were striking on the under-side. Some *Vanessas* showed the gradual disintegration, by exposure to a low temperature, of the ocellus on the fore wing, which in extreme specimens ceased to be an ocellus."

Various species of Vespa have been so abundant the past season in Great Britian that accounts of the "Plague of Wasps" have been occasionally published. Their unusual abundance is attributed to recent favorable meteorological conditions.

The U. S. National Museum has published in the Proceedings (No. 950) "A Descriptive Catalogue of the Harvest-spiders (Phalangiidæ of Ohio" by Clarence M. Weed. Fifteen species or subspecies are included in the list.

Prof. J. B. Smith describes [6]the new genus Tristyla with one species, and seven other new species of Noctuidæ collected by the Death Valley expedition.

In reporting on a collection of ants from Lower California and Sonora, Mexico, M. Theo Pergande describes[7] two new species of Camponotus and one each of Atta and Aphænogoster, as well as a new variety of *Pogonomyrex badius* Ltr.

Mr. Lawrence Bruner furnishes as his report as Entomologist to the Nebraska State Board of Agriculture a valuable discussion, covering more than one hundred pages, of the Insect Enemies of the Small Grains. The list includes 143 species distributed among the orders thus: Diptera, 24; Hymenoptera, 11; Lepidoptera, 22; Coleoptera, 33; Hemiptera, 28; Thysanoptera, 2; Orthoptera, 18; Thysanura, 3; Acarina, 2.

The peculiar pocket like abdominal appendages of female moths of the family Acræidæ are believed by A. F. Rogenhofer to be used in copulation.[8]

From recent studies of the pupæ of moths Dr. G. A. Chapman concludes[9] that the Pterophoridæ are not closely related to the Pyralidæ or Alucitidæ.

The discussion concerning the "highest" order of insects has been recently continued in *Science* by Packard, Smith and Riley, all of whom favor the placing of the Hymenoptera above the Diptera.

From recent anatomical studies, Krasilstschik concludes[10] that Phylloxera and Chermes should form the family Phylloxeridæ and should be regarded as more primitive than the Aphididæ or Coccidæ.

Dr. C. V. Riley's report as entomologist to the U. S. Department of Agriculture for 1892 discusses recent international exchanges of beneficial insects, the importation of two dangerous insects—the potato tuber worm (*Lita solanella* Boisd.) and the Olive Pollinia (*Pollinia costæ* Targ,)—the spread of the horn fly, the ox bot, the rose sawflies, the strawberry weevil, the elm leaf beetle and experiments with the European white grub fungus. In addition to these discussions there is a brief review of the work of the field agents of the division, and summarized accounts of the pea and bean weevils, the sugar-beet web worm (*Loxostege sticticalis* L.), the sugar-cane pin borer (*Xyleborus perforans* Woll.), and the new insectary of the department.

[6]Insect Life, V, 328—344.

[7]Proc. Cal. Acad. Sci., ser. 2, v. IV, pp. 26—36.

[8]J. R. M. Soc., 1893, p. 322.

[9]Trans. Ent. Soc. London, 1893, p. 97 et seq.

[10]Zoolog. Anzeiger, 1893.

A number of interesting entomological papers have been published by Mr. F. M. Webster in the third issue of the technical series of the Bulletin of the Ohio Experiment Station. Many new species of insects are described by specialists. The publication of these new species in such a bulletin is certainly of questionable propriety, unless they also appear in entomological journals. Such bulletins are of decided value and are useful outlets for much matter that accumulates in pursuance of station work—such as biographies, faunal lists, etc.—and it is desirable that they be confined to this instead of containing isolated descriptions of new species.

ARCHEOLOGY AND ETHNOLOGY.[1]

The "Plateau Implements" of Southern England.—It is natural to suppose, whether we believe in the skeleton of Castenodolo, the scratched bones of Monte Aperto, and the worked flints of Thenay and Otta or not, that man did not of a sudden manufacture "Turtle-backs" of Chellean type, and that somewhere on the globe stones flaked more rudely than the rudest of these, tell of his childish handiwork.

The question as to the 2500 flint pebbles, nicked, nipped, notched, saw edged, and sharp ended, called "Plateau Implements" and collected by Mr. Benjamin Harrison near Itham in Kent, England, is whether they are or are not artificial.

The gravels from which they come have not been geologically dated by intermixed fossils, but the beds—if not Tertiary must be far older than the drift "turtle-back" bearing strata of the Darent vale below them. They spread for miles along a ridge-top 340 feet above the sea, with no place to wash from and cannot therefore be connected with the present river system of South England.

Where the surface loam has been weathered off them, the yellow patinated "implements" are found lying on the gravel, and it is asserted that the latter are in place and not dropped there like the white chipped celts of Neolithic men that sometimes lie with them.

Careful trenching is needed to demonstrate the true position of these strange stones, duplicates of which Mr. Worthington G. Smith says he has found in the later drift deposits along with "Turtle-backs" near Dunstable, in Bedfordshire. But Professor Prestwich one of the first recognizers of Boucher de Perthes' discovery in 1859, views Mr. Harrisons specimens which now awaken contention, as the handiwork of men living before the time of the drift.

Quaternary Gravel Specimens in Spain.—In October, 1892, the Baron de Baye visiting the Quaternary gravel exposures at San Isidro on the right bank of the Mazanares opposite Madrid, bought from a workman two "Turtle-backs" (if we may here use the inoffensive word) one of quartzite and one of flint, of the type called Chellean by M. Gabriel de Mortillet (more or less leaf shaped and chipped on both sides) also one other specimen of flint of the pattern called Mousterian by de Mortillet (ie, chipped only on one side,)

[1] This department is edited by Mr. H. C. Mercer, University of Pennsylvania.

The workman told M. de Baye that he had found the Chellean and Mousterian specimens close together in the same top layer, and the latter repeated the statement before the meeting of the Societé de Anthropologie at Paris on July 15, 1893, reading also a letter from M. Siret the geologist who said he had discovered in the summer of 1892, 30 Chellean, 1 Solutrian (broad thin well worked leaf shaped blade) and 6 Mousterian specimens in the self same upper stratum.

Two Mousterian objects of this list were shown but how many of the 37 were found with M. Sirets' own hands in place does not appear.

If these stone Implement types running through the drift deposits and cave layers of France. (a) Chellean (River Drift), (b) Mousterian (cave period of chipping flakes on one side only) (c) Solutrian (cave period of finest blade chipping) and (d) Magdalenian (cave period of bone implements and animal sketching) represent cultural epochs in Mans' evolution as is claimed by M. de Mortillet, then these Spanish specimens should have been found in separate layers, or at intervals, and not all close together at about 6 to 15 feet from the surface.

M. de Mortillet objected at the meeting that hearsay did not prove the alleged mingling. He said that the two Chellean "Turtle backs" shown were not typical and believed that if the case were reconsidered a sequence of the types would be found in the different layers at San Isidro, as in France.

It was unfortunate that M. Siret was not there to explain his startling assertion that everything was unclassifiably jumbled together in the upper layer. But to find the Chellean at the top, was what I afterward did when I pulled out a leaf shaped "turtle-back" of flint[2] from the perpendicular bank of the Carreña Sacerdotal at a depth of 1·80 metres from the surface, on Dec. 31, 1892.—H. C. MERCER.

The non-existence of Paleolithic Culture.—Mr. J. D. McGuire in the American Anthropologist for July, 1893, denies the existence of a time when Man chipped but could not polish stone. Assailing not the antiquity of human remains but their cultural significance, and backed by his valuable and unique experience in the carving, polishing and boring processes of the stone age, he attacks Sir John Lubbocks celebrated definition as follows.

(1) Battering and grinding is easier than chipping and so must have preceeded it.

(2) Paleolithic Men made pottery for it is found in the Paleolithic

[2] Now in the Archæological Museum of the University of Pennsylvania at Philadelphia.

caves of Spy in Belgium (under Mousterian), Trou Magrite Belgium (with Mammoth and Rhinoceros), Nabrigas, France (with cave Bear), and Engis Belgium (with Rhinoceros).

(3) Paleolithic cave men bored and carved bone, and used pitted stone hammers at Les Eyzies, La Madeleine, Gorge D'Enfer and Laugerie Basse and therefore should have been able to polish stone.

(4) The absence of Drift specimens in Neolithic graves means that Drift "implements" in Europe are like American quarry "Turtle-backs" not implements at all and so not placed by the Neolithic men who made them, with their dead.

(5) Polished stone implements through made by Drift Men are absent from the Drift because the Drift beds were like American quarries where the stone chipper left no village relics.

(6) The Drift Mans' pottery is not in the Drift because even if lost there gravel washing would destroy it.

We follow these arguments with great interest but think (1) that while Indian blade making of the Quarry time was a complex difficult art, chip knife or "Teshoa" making at one blow, or "Turtle-back" making at 20 blows (if "Turtle-back" is all we want) is easier than hand hammering and grinding. (2) The 2nd argument warrants a review of the cave records, for if Paleolithic cave men did make pottery then the French classification collapses, and the Museums and Handbooks of Europe which it seems have failed to bring out the fact, are not to be trusted. (3) Why men who bored polished and carved bone, sketched realistic animal designs, and chipped blades equal in make to Mexican sacrificial knives did not polish stone seems incomprehensible. But the European Museums clearly assert that no polished stone tool has been found in the caves. If true, the fact is conclusive against Mr. McGuire. The finding of pitted hammerstones in Paleolithic caves involves a tendency to carving in the indentations themselves, but some of these hammers might have been corn and not stone bruisers after all, just as some such (Brough Smith's Aborigines of Victoria p. 385) were used by Australian native divers for clapping under water to scare fish into nets as well as to pound roots.

As to argument (4), the most striking European Drift form, the blunt based "Coup de Poing" is not like the turtle-backs in the American quarries examined. By no quarry turtle-back analysis can it be called an unfinished implement and so unadapted for deposit in graves.

If Neolithic Men made Coups de Poing as Indians made turtle-backs we should only have to go to a Neolithic Quarry to find them, but Spiennes, fairly considered, contains none.

To argument (5) it may be said that European Drift deposits are really analogous to our Riverside workshops where Indian relics are plenty, and not to quarries; while if we do compare them to quarries Indian relics have been found in my knowledge, at four. Realizing this we see no reason why polished implements should not be found in the Drift if the Drift Men made them. The 6th argument as to the destruction of pottery in washing gravel seems conclusive against expecting to find it there.

Thanks are due to Mr. McGuire for his exceedingly interesting and suggestive paper which should suffice to induce revision of the European Cave classification in which as it suggests there may be serious flaws.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, Biological Section, Nov. 20.—The following papers were read:—"On the Scope of Modern Physiology," by F. S. Lee; "Notes on recently discovered deposits of Diatomaceous Earths in the Adirondacks," by C. F. Cox; "Systematic Notes on Dracocephalum and Cedronella," by N. L. Britton.

December 4.—Professor H. F. Osborn described and exhibited a series of restorations of lower Miocene mammals including Titanotherium, Aceratherium, Metamynodon, Protapirus, Elotherium, Oreodon and other characteristic forms. This is the first of a series of tertiary mammal groups in preparation.

Mr. O. L. Strong described a new modification of the rapid Golgi method designed to eliminate some of its present defects, i. e., uncertainty of success and irregularity in the stain when attained, due probably in great measure to the feeble penetration of the silver nitrate.

The modification consisted in adding a certain proportion of sodium sulphate to the silver nitrate which the specimens are placed after the hardening in osmic-bichromate.

While this modification has hardly been tried sufficiently to ascertain exactly its merits, it seemed certain that in some cases, at least, it gave much more complete and uniformly stained pictures of the nervous system than the old procedure.

Specimens of the heart of a tadpole and cord of an embryo chick were exhibited.

Professor E. B. Wilson noted a mode of preparation of lobster testis which gave results especially favorable for class work in Cytology.

Bashford Dean, *Rec. Sec.*

Boston Society of Natural History, November 15th, 1893.—The following paper was read: Dr. J. Walter Fewkes, Comparative ceremoniology of the Mexican and Pueblo Indians.

December 6.—The folowing papers were read: Mr. R. E. Dodge, the Geographical Development of River Terraces; Professor W. M. Davis, Facetted Stones from Cape Cod. Both papers were illustrated by stereopticon views.

December 20.—The following papers were read: Mr. Severance Burrage, Observations on insectivorous plant, the thread-leaved Sundew (*Drosera filiformis Raf.*); Merritt Lyndon Fernald, On the geo-

graphical distribution of the flowering plants of the upper St. John River, northern Maine.

SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington.—Following was the programme of the evening. Symposium:—B. E. Fernow, C. W. Stiles, Theo. N. Gill, Geo. Marx and others; on what are the especial needs of the Biological Society of Washington.

December 2, 1893.—The following communications were read: Mr. Frederick H. Blodgett, Notes on the Development of the Bulb of the Adder's Tongue: Mr. E. W. Nelson, A New Species of Lagomys from Alaska; Dr. Erwin F. Smith, On a Bacterial Disease of Cucumbers, etc., working through the Fibrovascular Bundles; Probably Transmitted by Insects; Dr. C. W. Stiles, The Teaching of Biology in Colleges.

FREDERIC A. LUCAS, *Secretary.*

Odontological Society of Pennsylvania, Saturday, December 9th, 8 P. M.—William Romaine Newbold, Ph. D., of the University of Pennsylvania read a paper: "The Psychological Significance of Hypnotic Suggestion and Kindred Phenomena."

Dr. Thomas Fillebrown of Boston, Mass., opened the discussion. The following is an abstract of Dr. Newbold's paper.

The psychical phenomena of the hypnotic state can for the most part be regarded as due to heightened suggestibility. Suggestibility is found in all normal persons and occurs not infrequently in pathological degree. It can be connected with the conception of the mental state as representing to us cortical processes and hence as a dynamic thing, due to definite causes and necessarily involving definite effects.

Normal perceiving and thinking involves the functioning of the cortex as a whole composed of parts more or less differentiated functionally and standing in multiple intercorrellations with one another. Hence in normal life the effects of any given cortical process or mental state can never be dissociated from those of preëxisting activities and predispositions.

In the condition known as heightened suggestibility, by whatever agency it be produced, the cortical coördination is unimpaired; those activities which chiefly modify the nascent process or state being temporarily inhibited; we can study at leisure the development and results of any artificially produced process, whether connected with consciousness or not.

The kindred phenomena of "the fixed idea," "hysteria," "epilepsy," "double consciousness," etc., are due to analagous disturbances in cortical coördination with sundry local complications.

The relation of consciousness to such states is obscure. In some it undoubtedly exists; in some its existence is questionable.

If the occurrence of telepathic phenomena be admitted, they must be explained rather by the conveyance of suggestion by some means at present unrecognized than as proving the existence of some unknown force in the operator constraining the subject to perform acts against his own will.

ALONZO BOICE, *Secretary.*

SCIENTIFIC NEWS.

The University of Kansas has issued six numbers of the "Kansas University Quarterly." The Natural History articles so far published are as follows:—Kansas Pterodactyls, pts. 1 & 2, by S. W. Williston; Kansas Mosasaurs by S. W. Williston and E. C. Case; Notes and Descriptions of Syrphidæ by W. A. Snow; Notes on *Meliteria dentata* and the Sclerites of the head of *Danais archippus* by V. L. Kellogg; Diptera Braziliana pts. II & III; the Apioceridæ and their allies, and new or little known Diptera by S. W. Williston; The Great Spirit Spring Mound and the Delicacy of the sense of taste among Indians by E. H. S. Bailey; Notes on some Diseases of Grasses by W. C. Stearns; Revision of the genera Dolichopus and Hygroceleuthus and new genera and species of Psilopinæ by J. M. Aldrich. The Quarterly is well gotten out and reflects much credit upon the University.

Professor Hermann A. Hagen died in Cambridge, Mass., Nov. 8th, 1893. He was born in Königsberg, Prussia, May 30, 1817, and received his M. D. from the University there in 1840. Later he studied in Berlin, Vienna, Paris and other European cities. Meanwhile he devoted considerable attention to entomology, and in 1843 published his first paper "Prussian Odonata" This publication gave him considerable reputation. In 1843 he returned to Königsberg, entered on the general practice of medicine, and for three years was first assistant in the Surgical Hospital. From 1863 until 1867 he was Vice-President of the City Council and member of the school board. He became acquainted with Louis Agassiz, who invited Prof. Hagen to leave Germany and come to Cambridge. Prof. Hagen accepted the offer

and became assistant in entomology at the Agassiz Museum. In 1870 he was made Professor at Harvard. Since that time Professor Hagen has kept his connection with the Harvard University, and for years has been one of the most famous men in the University. Professor Hagen's contributions to the science of entomology have been of great value. He received the honorary degree of Ph. D. from the University of Königsberg in 1863, and in 1887 Harvard conferred upon him the honorary degree of S. D. His publications include more than 400 articles, of which the most important was his "Bibliotheca Entomologica," published in Leipzig in 1862.

The stratigraphical collection of Canadian rocks on exhibition at the Columbian Exposition, Chicago, has been catalogued by Mr. W. F. Ferrier. The collection comprises 1500 specimens, and illustrates all the formations known to occur in the Dominion of Canada, from the Laurentian to the Pleistocene. As the collection is very complete, geographically, it is proposed to incorporate it with that already in the Museum of the Canada Geological Survey and thus form an unrivalled series of the rocks of Canada.

Erratum in note of a paper by Mrs. E. G. Britton, on page 826, line 24 from top, the sixth word should be *disproved.*

Albert F. Woods, Assistant in Botany in the University of Nebraska, has been appointed Assistant Pathologist in the Section of Vegetable Pathology of the Department of Agriculture in Washington.

"Briefly describe the heart and its function or work." Ans. "The heart is a comical shaped bag. The heart is divided into several parts by a fleshy petition. These parts are called the right artillery, left artillery and so forth. The function of the heart is between the lungs. The work of the heart is to repair the different organs in about a half minute."

"What are metamorphic rocks?" Ans. "Rocks that contain metaphors."—*London Globe.*

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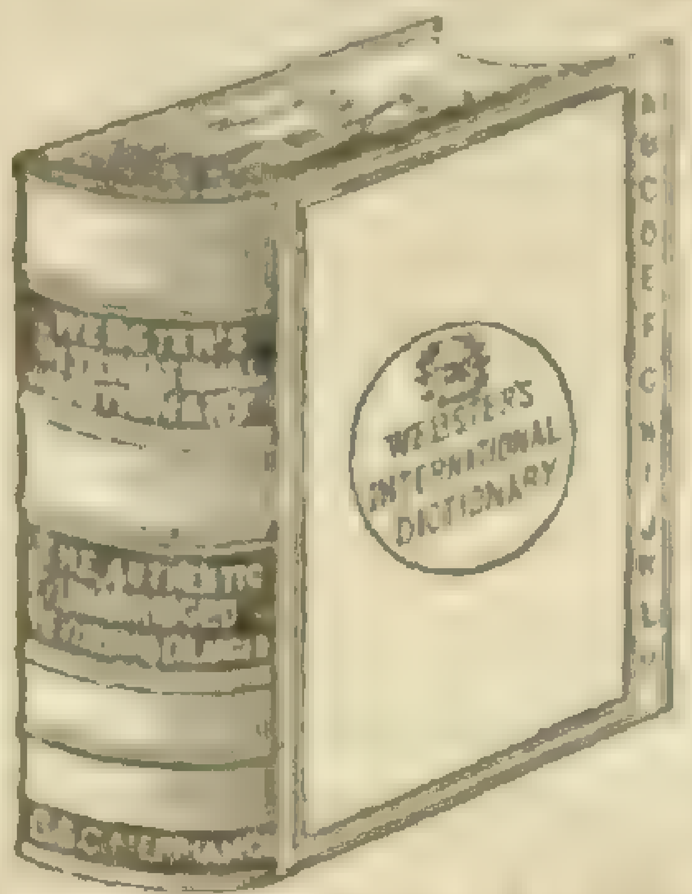

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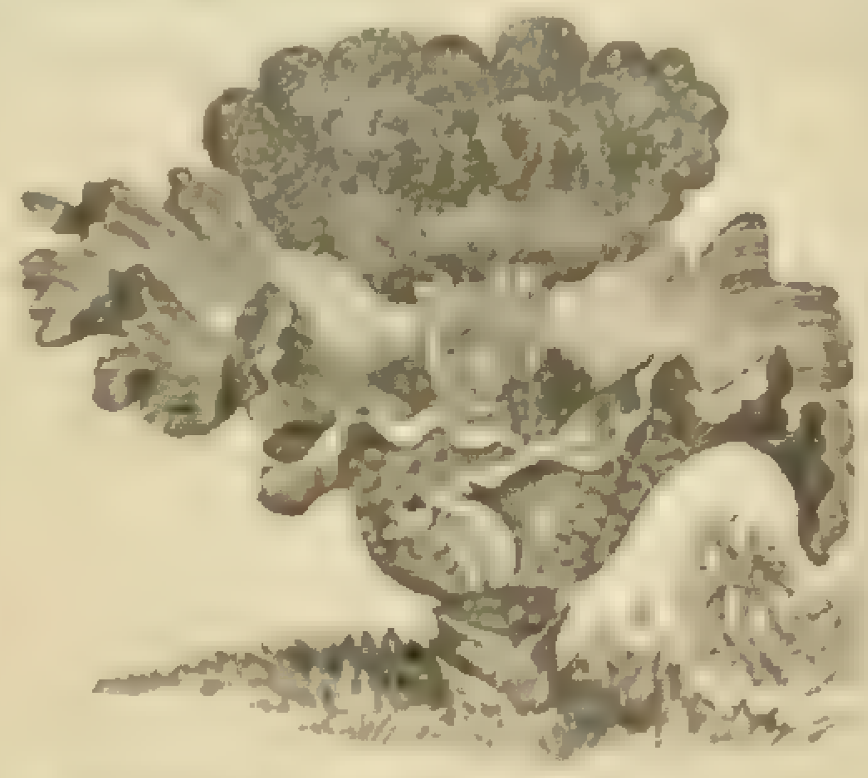

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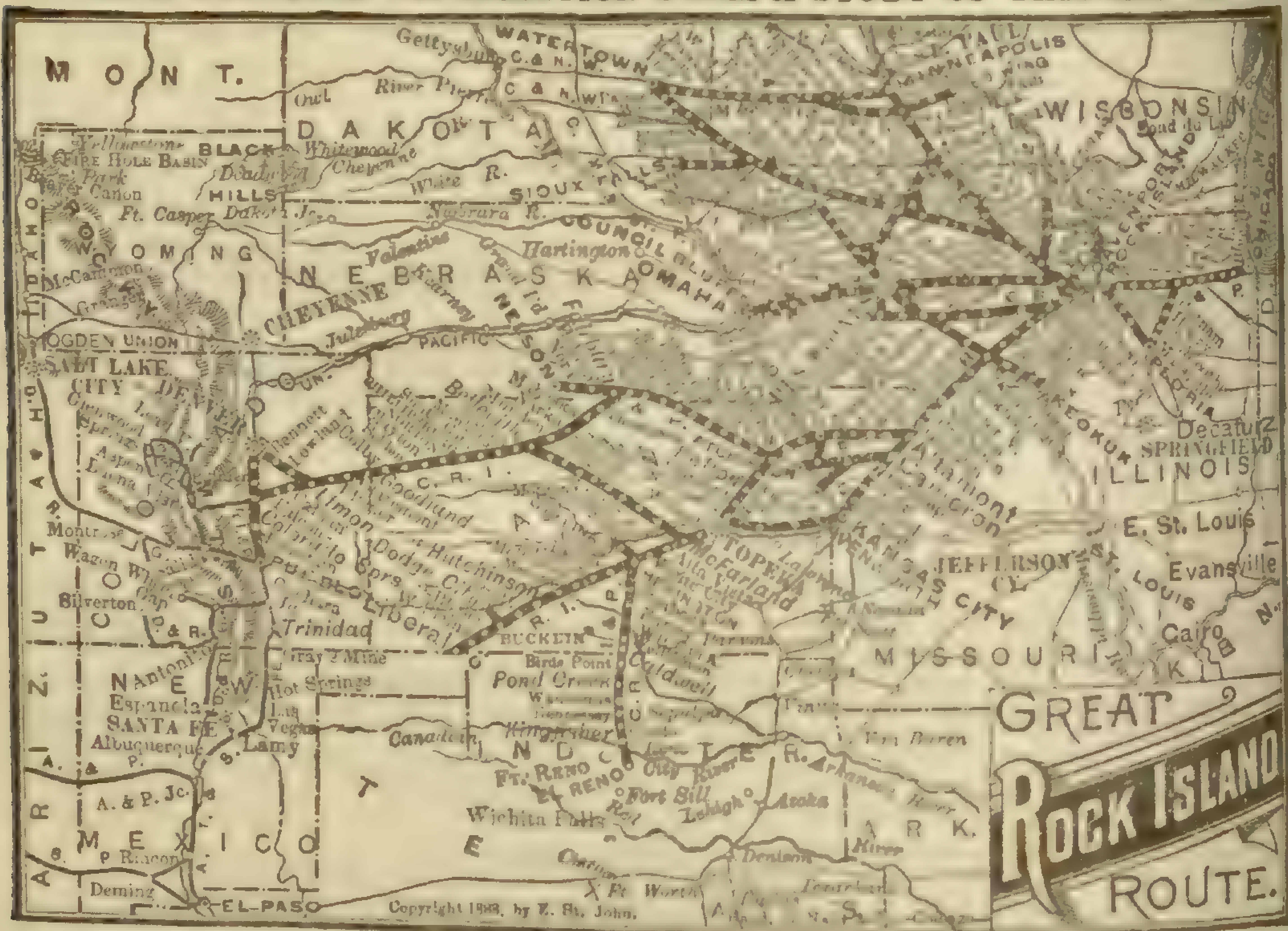

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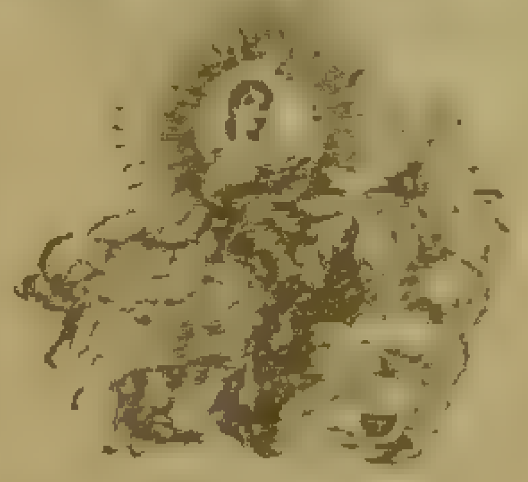

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THE

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SOME RECENT CHEMICO-PHYSIOLOGICAL DISCOVERIES REGARDING THE CELL.[1]

By R. H. Chittenden.

In opening this discussion, or rather in making such remarks as seem appropriate in connection with the subject before us for consideration this morning, I am reminded that the chemistry and the chemical processes of the cell have received very little attention from the generality of biologists. This is perhaps natural, since the morphological side of biology has for many years presented a more attractive field for the majority of scientific workers, and the difficulties have not been so great as in the chemical and physiological problems awaiting solution.

Simplicity of structure, as embodied in the single cell of a unicellular organism, means to the physiologist increased complexity of function. In the higher organism with its many groups of cells, we can easily comprehend how one group may be characterized by one line of functional activity, while a neighboring group of cells in the form of another tissue or organ is endowed with functional activity of quite a different order. One group of cells is set apart for one line of duties, while another group has quite different functions; in other

[1] The Introductory paper in a discussion of our present knowledge of the cell at the meeting of the American Society of Naturalists, New Haven, Dec. 28, 1893.

words, structural differentiation has begotten or accompanied chemical and functional differentiation. All this seems quite plausible, indeed, quite natural, but how shall we explain all the varied functions possessed by the unicellular organism unless we accept the idea of a possible chemical differentiation of the cell protoplasm inside the cell wall. Digestion, assimilation, excretion and reproduction are functions possessed alike by the unicellular organism and its higher neighbor the multicellular organism. In the latter, we recognize distinct groups of specially characterized cells for each phase and form of functional activity, each group as in a gland or tissue having a different chemical structure with its own peculiar line of chemical activity and its own particular katabolic products. In the unicellular organism, on the other hand, a differentiation of protoplasmic particles is the only plausible explanation of the diverse functions of the living cell.

This being true we can no longer look on the cell as the ultimate unit of structure, certainly not from the chemical standpoint. The cell may be considered rather as a complex molecule, or series of molecules, built up of many morphological atoms or rather groups of atoms. Thus, the cytoplasm, for example, may be looked upon as a multitude or mass of living units of structure, as the plasomen of Wiesner. Call them what you will—plasomen, idiosomes, gemmules, plastidules, idioblasts or physiological units—these particles have the power of dividing, and, indeed, of growth and assimilation. Moreover, it is possible that this power of growth and reproduction may be independent, in part at least, of the cell nucleus and the constituent karyoplasm. Furthermore, the nucleus too may perhaps be considered as composed of auto-divisible organic individuals, these hypothetical particles, both of the cytoplasm and of the karyoplasm, being considered as the living atoms of the molecule, the last divisible living bodies of the cell.

For fifty years or more, the cell theory of structure and development as outlined by Schleiden and Schwann has been the nucleus for nearly all phases of biological work, and although our knowledge of the cell has advanced greatly in

all directions during the last half-century, yet nearly all the problems of life are still viewed from the standpoint of the cell theory; morphological facts and physiological facts are all tested more or less by their relationship to cell structure and cell function. As Whitman[2] has aptly said "all the search-lights of the biological sciences have been turned upon the cell; it has been hunted up and down through every grade of organization; it has been searched inside and out, experimented upon, and studied in its manifold relations as a unit of form and function", and yet, if I understand the matter aright, many morphologists to-day are inclined to protest somewhat against "the complete ascendency of the cell as a unit of organization." We must not ignore the existence of the organic chemical compounds, with their peculiar molecular structure, which compose the cell protoplasm; the whole secret of organization, assimilation, growth, development, etc., may rest upon these ultimate elements of living matter. These may be the actual representatives of the physiological units of Herbert Spencer, or the plasomes of Wiesner; they may be the real units of all forms of living matter, the bearers of heredity and the true builders of the organism whether it be simple or complex. These protoplasmic particles are not necessarily limited in their action, or in the influence they exert, by cell walls or other boundaries.

The physiologist, however, like all other biologists, has been wont to look upon the cell as "the unit of the manifold variable forms of the organism" (Hammarsten), representing the seat of the many varied chemical processes characteristic of the individual tissues and organs. The cells naturally, through their variable activity, govern the range and intensity of the metabolic processes of the organism; but all this is simply a general expression of the idea that the chemical processes of the higher organism are localized in the cellular tissues of the body rather than in the adjacent fluids. It appears to me that we have every reason to believe in the existence of ultimate particles of living matter, both cytoplasm and karyoplasm, in-

[2] The inadequacy of the cell-theory of development. Journal of Morphology, Vol. 8, p. 639.

side the cell, which are the real units of the organism. They may not be recognizable morphologically, but they exist nevertheless as individual links in that chain of molecules of which we believe living protoplasm to be composed. As Quincke[3] has recently said " bioiogical science must, well or ill, take into account the fact that the development of the cell and the life of organic nature depends on masses and layers which cannot be seen by the microscope alone." Hence, the chemistry of the cell offers an interesting field of work full of promise, although for the most part it has been studied mainly with a view to obtaining more light regarding the general metabolic processes of the higher organisms.

From a chemical standpoint, the living animal cell may be considered as a combination of varied chemical substances always in a state of unequilibrium, unstable in the highest degree, readily prone to break down by oxidation or cleavage into bodies of less complexity, each downward step in the process of disintegration, giving rise to the liberation of a certain amount of energy. These explosive, or it may be gradual, decompositions are going on continually as long as life endures, and chemical transformations and chemical decompositions are therefore an essential part of the life history of the cell, or of the organism of which it is an integral part. In them are hidden many of life's mysteries, and some of the most intricate as well as important phases of physiological phenomena are closely connected with these more or less obscure chemical transformations.

This constant liberation of energy, so characteristic of the living animal cell, coming as it does from the continued disintegration of the living substance of the organism creates a demand for fresh material to supply the place of that which has undergone this vital decay, otherwise the vital energies flag and the bodily structure withers away. The food material supplied to meet this demand, although it may be easily oxidizable or combustible cannot supply the needs of the organism without becoming vitalized. As dead, inert matter it is simply combustible; it can exhibit energy as heat only like

[3]Nature. Vol. 49. p. 6.

other forms of organic matter, but its energy cannot be made available in the manner required by the living animal organism. It must first be fitted for assimilation through digestion or otherwise; after which, having passed into the circulating fluids, it finally reaches the cell under whose influence it undergoes a final change by which it is raised to a higher plane. That which was dead has become alive, a chemical transformation has occurred, the atoms in the molecule have been rearranged and we have to deal with living matter; a change accomplished through the anabolic power of the living cell, or better of the cell protoplasm. Anabolism and katabolism, construction and destruction, are thus going on continually in the living animal cell side by side as a necessary concomitant of life, but the processes are not everywhere of the same order. They are qualitatively and quantitatively unlike, especially the katabolic, the latter showing some peculiarities characteristic of almost every individual group of cells as comprised in individual organs or tissues. Each individual cell as a component of the many and varied tissues of the organism is to be compared to a well equipped chemical laboratory, the character and amount of the work produced being dependent in part upon the intrinsic qualities of the cell, *i. e.* of the cell protoplasm, and in part upon the nature of its surroundings or environment. While these statements apply more particularly to the animal cell, they are likewise true of the vegetable cell, the only difference being that in the latter we find a predominance of synthetical processes, a remarkable power of building up complex substances such as starch and proteid out of the simple food material obtained from the air and the soil, while the animal cell is especially characterized by the extent of its katabolic processes.

It is thus very evident that while in the early stages of growth and development, all animal cells, for example, may show a striking similarity in composition, as soon as differentiation in form begins to manifest itself with an accompaniment of functional activity, chemical composition is gradually altered until at last each group of cells characteristic of the individual organs and tissues acquires a composition peculiar

to itself. Obviously, however, the most striking differences are manifested in the character of the so-called secondary constituents of the cell protoplasm, *i. e.* the katabolic products of the cell's activity, such as the different enzymes or their antecedents, the albuminoids, pigments, fat, glycogen, etc., to which must be added the substratum of dead food material for the nutrition of the cell. From this very diversity in the character of the katabolic products of protoplasmic activity, we might easily argue corresponding differences in the character of the primary constituents of the cell protoplasm, which in turn would imply fundamental differences in the nature of the anabolic processes by which the cell protoplasm is formed.

It will be seen from what has just been said that it is not an easy matter to discriminate between the primary constituents of a cell and the so-called secondary constituents, or such as arise from the katabolic activity of the primary bodies. Furthermore, it is an extremely difficult matter to isolate from a given tissue or organ the active cells entering into its structure, or to collect together a sufficient number of unicellular organisms free from impurities or admixtures. When, however, this has been accomplished and we are ready to analyze the isolated cells, we are at once confronted with the limitations attending this kind of work, especially the fact that any ordinary method of separation or analysis, even the initiatory steps in the process, immediately transforms the living matter into dead matter, which transformation may be accompanied by cleavage or other chemical changes of more or less complexity; so that the bodies we identify as components of the cell protoplasm may be simply alteration products, or fragments of the larger and more complex molecules resident in the living matter.

From microscopical examination we have evidence that protoplasm is far from being homogeneous, that it is loaded with granules and pervaded by a mesh-work of irregular arrangement. These various forms of protoplasmic differentiation have, as you know, been variously named by different investigators, as the spongioplasm, paraplasm, hyaloplasm, etc.,

and we are led to infer marked differences in chemical composition from the behavior of the several parts of the cell toward the many pigments or dyes used in histological investigation. There can be no manner of doubt that the differences in color between the nucleus and the cytoplasm of the cell, for example, as brought out by the agency of various pigments is due to differences in chemical composition. Again, as you are well aware, Ehrlich has been able to discriminate between the different varieties of granules found in cell protoplasm by their behavior toward neutral, acid and alkaline aniline dyes. Thus, in the centresome we have a mass of differentiated cytoplasm, which as Watasé[4] has shown in the egg of Unio, may be made to stand out with great distinctness by means of acid-fuchsin, while the spindle fibres and the rays of the aster remain practically unstained, thus clearly pointing to differences in chemical composition which are well worthy of note. Again, there are still other granules frequently present in the cytoplasm of many cells, staining dark with osmic acid, which indicate still other differences in chemical composition. But our knowledge concerning the chemical nature of protoplasm is far too imperfect and scanty to admit of our drawing any other than the broadest generalizations from the affinity the protoplasm may show for various pigments.

Further, as you well know, the nuclear constituents have been divided by various investigators, as by Flemming, into several groups according to the action of different stains; thus, we have the chromatic substance or chromatin, which stains readily with the aniline dyes and which comprises especially the nuclear network, then achromatin, or that portion of the nucleus which does not stain readily, as the nuclear matrix and the nuclear membrane.

Such statements as these may be added to almost indefinitely, but for our purpose the above are amply sufficient to indicate the existence of marked chemical differences in the cell cytoplasm and karyoplasm. And, indeed, that is all they do indicate; they give us very little knowledge of the real nature of the substances which are the cause of these differ-

[4]Homology of the Centresome. Journal of Morphology, Vol. 8, p. 433.

ences in reaction. We must have more definite chemical knowledge before we can hope to attain to a clearer understanding of the actual make up of cell protoplasm. Further, such knowledge is not to be obtained solely by micro-chemical study. The latter is surely important, but macroscopical methods must be relied upon mainly to furnish the desired information, and when we have full knowledge of the chemical nature of the substances present in the protoplasm, we may hope to find micro-chemical methods adapted to their accurate detection.

What now is the state of our knowledge regarding the primary constituents of cell protoplasm? Taking the results which have been elaborated by painstaking work during the last ten years, I think we are justified in asserting that the primary constituents of the cytoplasm are especially a peculiar group of proteid or albuminous bodies known as nucleo-albumins and characterized by containing phosphorus. These are by far the most numerous of the substances present in the cytoplasm. Next in importance are simple proteids belonging mainly to the group of globulins, a class of albuminous bodies insoluble in water but readily dissolved by 5–10 per cent. salt solution. Lecithin comes next, a complex phosphorized body having a constitution similar to that of a fat and yielding by decomposition higher fatty acids, glycero-phosphoric acid and cholin. This body is also insoluble in water and likewise in salt solution, but is readily dissolved by ether and somewhat by alcohol. Another substance almost invariably present in cytoplasm is cholesterin, a solid crystalline alcohol of somewhat uncertain constitution, insoluble in water and salt solution, but readily soluble in alcohol and ether. The remaining constituents of the cytoplasm are the inorganic elements calcium, magnesium, potassium and sodium united with chlorine and phosphoric acid to form chlorides and phosphates respectively. It may be somewhat questionable whether all of these latter salts are primary constituents of the cytoplasm, although it seems quite certain that potassium which is present in fairly large quantities in animal cells is a true primary constituent. Potassium phosphate is certainly

of primary importance for the life and development of the animal cell, as no doubt also are the earthy phosphates, although we can hardly formulate how they exist in the cytoplasm unless it be in close union with the proteids or nucleo-albumins of the cell, for which we know they have a strong affinity. Again, it is to be remembered that the ash of all cells shows the presence of a certain amount of ferric oxide. This, however, does not come from ordinary iron salts present in the protoplasm, but the iron appears to exist in some peculiar organic combination, apparently united to carbon. It is especially to be noted as a component of so-called iron-containing nucleins, or nucleo-albumins.

It is thus seen that proteid matter in some one or more forms, mostly as nucleo-albumins, constitutes the great bulk of cytoplasm, and the typical anabolic product of the living cell is unquestionably represented by a molecule, or molecules, in which proteid matter occupies a prominent place. "But that the albumin molecule is alone the bearer of life and all the other constituents of the protoplasm its satellites we certainly cannot affirm." (Kossel)

Between the cytoplasm and the karyoplasm there is very little constant difference. The one typical constituent of the cell nucleus, however, is nuclein or one of the bodies of that group. It is important to note in this connection that such examinations as have been made show that the primary constituents of the cell may be located in the nucleus in great part, or they may be evenly distributed through both cytoplasm and karyoplasm, or indeed they may be almost wholly wanting in the nucleus, occurring only in the cytoplasm.[5] This latter condition offers a ready explanation of the well-known fact that cells rich in nuclei and consequently containing only a little cytoplasm, as the spermatozoa, are extremely poor in many of the primary bodies of ordinary cells. The one body, however, characteristic of the cell nucleus is nuclein.

Cholesterin and lecithin are certainly common to both cytoplasm and karyoplasm, being found abundantly in cells rich

[5]Kossel. Verhandlungen d. physiol. Gesellschaft zu Berlin, Feb'y, 1890.

in nuclei as well as in cells poor in nuclear elements. We must reiterate, however, that the first place in importance among these so-called primary bodies is to be ascribed to the proteids in all living cells, for it seems more than probable that the nucleins and the lecithins found in cell protoplasm are constructed synthetically out of certain cleavage products of the proteids and phosphates. However this may be, the globulins, nucleo-albumins and nucleins are, so far as our present knowledge extends, the important constituents of cell protoplasm in all animal and vegetable cells. Of these three classes of bodies, the nucleins and the related nucleo-albumins are deserving of special notice.

The substance originally known as nuclein and first identified by Hoppe-Seyler and Miescher as the main constituent of the nucleus of pus cells was prepared by a number of investigators from different kinds of material rich in nuclei, or nuclear substance. Thus, Miescher prepared it from the spermatozoa of different animals, Geoghegan from the brain, Hoppe-Seyler from yeast cells, Plósz from the liver and von Jaksch from the human brain. The products obtained, however, while showing certain points in common, were unlike each other in many respects. Thus, they were all alike in containing a noticeable amount of phosphorus, but the percentage of phosphorus was found on analysis to vary from 1.8 per cent. up to 9.5 per cent. Again, the several products differed in their degree of solubility in alkalies, some being very soluble and others only slightly so. These marked discrepancies were naturally considered as implying that the so-called nuclein was not a chemical unit, but rather an indefinite mixture of organic phosphorus compounds with proteid matter; but we now know, thanks to the painstaking work of Kossel and others, that there are a group of closely related bodies, *nucleins*, widely distributed in nature, wherever cell structure is to be found, as the main constituent of the cell nucleus, and likewise present in certain substances such as milk and egg-yolk which serve as food for developing animals. The latter class are better known as nucleo-albumins, from which a typical nuclein can be separated or rather prepared by the

proteolytic action of the gastric juice,[6] which dissolves away the excess of proteid matter leaving a non-digestible nuclein. The essential points of difference between the typical nucleins are made clear by a study of their cleavage products. Thus, the nuclein found in the karyoplasm of most cell nuclei on being boiled with dilute sulphuric acid, yields as cleavage products, phosphoric acid, xanthin bodies and acid-albumin. The nuclein, on the other hand, present in the sperm of the salmon fails to yield any albuminous matter, its cleavage products being only phosphoric acid and hypoxanthin. The third group of nucleins, better known as nucleo-albumins, yield only phosphoric acid and albuminous bodies by cleavage, the xanthin bases, if formed, being in too small quantity to admit of certain detection. From the nuclein of yeast cells, Liebermann obtained by cleavage metaphosphoric acid, and both he[7] and Pohl were able to prepare a combination of metaphosphoric acid with egg-albumin, also with serum-albumin and with albumose, resembling nuclein in properties. Furthermore, by varying the proportions of acid and albumin it is possible to prepare different forms of nuclein, varying in their content of phosphorus, and in their solubility in alkalies, like the natural nucleins obtainable from cell nuclei. It is questionable, however, whether these synthetical products are in every way akin to the natural nucleins, for it seems probable that the nuclein molecule formed through the activity of the living cells is constructed on a somewhat different plan, so far as the arrangement of the atoms is concerned. Thus, Altman[8] has shown that when a nuclein is subjected to a mild process of decomposition, as on exposure to the action of an alkali at ordinary temperature, it is broken apart into albumin and a peculiar acid rich in phosphorus, to which the name of nucleic acid has been given. Moreover, it is possible to regenerate the nuclein out of these two components, the body so reconstructed having all the properties of the original substance. Nucleins, therefore, to quote Halliburton, may be considered

[6] Compare Lilienfeld Du Bois Reymond's Archiv f. Physiol. 1892, p. 129.
[7] Liebermann. Pflüger's Archiv für physiologie Bd. 43 p. 99.
[8] Ueber Nucleinsäuren. Du Bois Reymond's Archiv für Physiol, 1889, p. 524.

as compounds of proteid substances with nucleic acid, the various members of the group differing in the proportion of proteid matter to this phosphorus-rich acid. Thus, we may have a chain of nucleins, one end of the series being represented by nucleic acid itself with its 9 to 11 per cent. of phosphorus and without any admixed proteid, such for example as is found in the heads of the spermotozoa, which are doubtless derived from the nuclei of the spermatogenic cells; while in the middle of the series are the nucleins proper consisting of proteid with varying amounts of nucleic acid, and at the other extreme nucleins composed almost entirely of proteid, containing at the most only 0.5 to 1.0 per cent. of phosphorus and represented by the substances generally known as nucleo-albumins.

Nucleins are not digestible in artificial gastric juice, while a nucleo-albumin, as already stated, undergoes a partial digestion, the excess of combined proteid matter being converted into soluble products, while a typical nuclein remains as an insoluble residue, which however may be dissolved by weak alkalies. With this understanding of the general character of the nucleins, many of the micro-chemical observations recorded by different workers in cytology become intelligible. Take as an illustration the work of Zacharias[9] on vegetable cells. This observer, as you remember, made a large number of digestive experiments with artificial gastric juice, and noted the occurrence in the nucleus of two distinct substances indigestible in pepsin-acid solution, which differed from each other in their solubility in acids and alkalies. As a result, Zacharias states that the resting cell nucleus consists of a ground mass composed in great part of nuclein, while the nucleoli consist of albumin and plastin. Remove the albumin from the nucleus by digestion, and the nuclein will dissolve in dilute alkali, leaving a network of plastin. Further, Zacharias states that plastin is an essential constituent of the total protoplasmic content of the cell, including the nucleus and the chromatophore. Now, note the differences between the nuclein and the plastin as defined by Zacharias. Plastin,

[9]Botanische Zeitung. 45th Jahrgang, pp. 281 and 329.

for example, does not dissolve or even swell up in 10 per cent. salt solution, hence it is not a globulin or simple proteid; further, it does not disappear on treatment with hydrochloric acid of moderate strength, as nuclein does. Again, plastin is much more difficultly soluble in alkalies than nuclein. Now as a matter of fact these two bodies have an extremely close relationship; they are both nucleins, having the same general type of structure; they differ merely in the proportion of nucleic acid and pröteid. The plastin of the histologist, therefore, is simply a form of nuclein, less acid in character because it contains less nucleic acid and a larger proportion of proteid; hence, it likewise contains less phosphorus and for the same reason is more insoluble in alkalies.

In a general way we may say that the so-called nuclear sap or nuclear matrix is composed practically of a globulin-like body, just such as is found in the cytoplasm and which by digestion with artificial gastric juice is converted into soluble products, as proteose and peptone. The bulk of the nucleus, however, is composed of material insoluble in gastric juice. The bodies composing this indigestible matter are all phosphorized; in fact, they are nucleins of various kinds. Thus, the so-called chromatin network which is distinguishable from all other constituents of the cell by its strong affinity for various dyes is composed of a nuclein rich in phosphorus, viz.: a nuclein with a large content of nucleic acid and a corresponding smaller content of proteid. The nucleoli, on the other hand, which have a less pronounced affinity for dyes than the chromatin, are composed mainly of the so-called plastin, *i. e.* a nuclein comparatively poor in phosphorus and not readily soluble in alkalies. In other words, and this I think is the point deserving of special emphasis, the cell nucleus in all cells is composed mainly of nucleins, compound bodies made up of proteid matter and nucleic acid, the latter rich in phosphorus, the individual parts of the nucleus varying somewhat in accord with the varying character of the nucleins as determined by the proportions of proteid to nucleic acid. That is to say, "in the processes of vital activtiy there are changing relations between the phosphorized con-

stituents of the nucleus, just as in all metabolic processes there is continual interchange, some constituents being elaborated, others breaking down into simpler products."[10] We are not to forget, however, that these bodies may possibly be fragments of still more complex molecules resident in the living karyoplasm of cell nuclei. In any event, the character of these fragments, if such they are, must tell us something as to the nature of the original molecules, and consequently on the basis of the above statements we may reasonably argue the probable existence of different, though closely related, chemical varieties of karyoplasm as peculiar to the cell nuclei of individual organs and tissues.

Lilienfeld,[11] however, while accepting in a general way the views already expressed emphasizes the probability that as a rule there is a constant difference between the nucleus and the body of the cell, in that the former in every phase of life consists mainly of nuclein substances, *i. e.*, nucleo-proteids, nuclein and in extreme cases nucleic acid, while the body of the cell is composed mainly of pure proteids and nucleo-albumins with a low content of phosphorus. But as there are changing relations between these individual bodies, the tone of color obtainable by different dyes is obviously more or less variable; but as a rule, we may say that the nuclein-containing bodies of the nucleus have the strongest affinity for basic dyes, while the proteids of the cell body naturally seize hold of the acid dyes.

Further, Lilienfeld, who has recently made a thorough study of the inner structure of leucocytes and has named the characteristic constituent of the nucleus, *nucleo-histon*, describes this body as a nucleo-proteid, a body comparable to a chemical salt composed of a proteid base, histon, and a complex acid, leukonuclein, which in turn is made up of nucleic acid and proteid. So that in this the latest work in this direction that I am familiar with, we find results all bearing out the general statements just submitted.[12] Again, Lilienfeld has shown

[10] Halliburton

[11] Verhandlungen der Berliner physiologischen Gesellschaft. Du Bois Reymond's Archiv für Physiologie. Jahrgang, 1893, p. 391.

[12] Compare Lilienfeld "Zur Chemie de Leucocyten." Zeitschr. Phyiol. Chem. Band. 18, p. 473.

that it is the nucleic acid of the nucleus which is the primary cause of the pronounced color shown by this portion of the cell on treatment with aniline dyes.

With this understanding of the wide-spread distribution of nucleins throughout all animal and vegetable cells, let us consider somewhat more in detail the character of their decomposition or cleavage products, for this may give us a clearer insight into their general nature. As already stated, the nucleins thus far studied yield on treatment with dilute mineral acids a row of peculiar crystalline nitrogenous products, the xanthin bases so-called, the true antecedent of which Kossel has shown to be nucleic acid. Hence, the yield of these bodies, which, by the way, belong to the uric acid group, must depend upon the amount of nucleic acid contained in the given nuclein. The wide-spread distribution of these bodies, throughout the animal organism especially, wherever cell activity is pronounced, their close connection with uric acid and their evident origin in the nucleic acid of cell nuclei are facts of great physiological importance, since they throw possible light upon the physiological function of the cell nucleus and at the same time point to a genetic connection between the nuclein bases and uric acid. This phase of the matter, however, we cannot now consider, but there are one or two points connected with these nuclein bases that we cannot afford to pass by. First, the bases themselves are four in number, viz.: adenin, guanin, xanthin and hypoxanthin, all well defined bodies of known chemical constitution. Among these, adenin stands foremost. It is, to be sure, the one most recently discovered, but its characteristic chemical nature and constitution give it a peculiar prominence the others do not possess. It is not only a product of the chemical decomposition of pure nuclein by dilute acids, but it is widely distributed in nature, and its distribution in the organs and tissues of animals and plants corresponds to its genetic relationship to the characteristic constituent of the cell nucleus. Thus Kossel[13] has obtained it from the pancreatic gland and from the spleen, also from yeast cells and from tea leaves, but found it

[13] Zeitschrift für physiologische Chemie. Band 12, p. 241.

wanting in muscle tissue, poor in nuclei. F. Kronecker[14] found it in the spleen, lymph glands and kidneys of oxen, while Stadthagen[15] found it present in the liver and urine of a patient suffering from leukæmia, a disease in which the white blood cells are enormously increased in number. It is not to be understood, however, that the adenin exists wholly free in these cases. On the contrary, it exists in plant and animal tissues in loose combination, in part at least, with albumin and phosphoric acid. This combination is easily broken by the action of dilute acids, especially at 100° C., and also by spontaneous decomposition after death, *i. e.*, the adenin is an integral part of the nucleic acid which is present in all cell nuclei, and under certain conditions can be split off from the complex molecule of which it is an integral part.

In composition, adenin is peculiar in that it contains no oxygen. It is composed solely of carbon, hydrogen and nitrogen in such proportion as to warrant the conclusion that it is a polymer of prussic acid, HCN. It has in fact the same percentage composition as prussic acid, and its ready convertibility into potassium cyanide by fusion with caustic potash at 200° C., testifies to the close relationship between these two bodies. The existence of cyanogen compounds in the animal body has long been suggested as theoretically probable, and the finding of adenin gives to this hypothesis a substantial basis and points to the cell nucleus as the seat of these cyanogen compounds. Further, adenin is closely related to hypoxanthin, a body with which we are more familiar and whose origin we shall need to consider. Moreover, we find when we come to study relationships that all the so-called nuclein bases are closely related to adenin, as is seen from the following formulæ, which bring out the analogies quite clearly:

Adenin	$C_5H_4N_4$ NH	Guanin	$C_5H_4N_4O$ NH
Hypoxanthin	$C_5H_4N_4$ O	Xanthin	$C_5H_4N_4O$ O

Both adenin and hypoxanthin contain a peculiar chemical group $C_5H_4N_4$, called by Kossel and Thoiss[16] adenyl, and we

[14] Virchow's Archiv. Band 107, p. 207.
[15] Ibid. Band 109, p. 390.
[16] Zeitschrift für physiologische Chemie. Band 13, p. 396.

may consequently consider adenin as adenylimid, while hypoxanthin may be appropriately termed adenyloxide. As might be expected from the close relationship between these two bodies, adenin can be readily converted into hypoxanthin; and in a similar manner the allied base guanin can be transformed into xanthin. Thus, Schindler[17] finds by experiment that adenin dissolved in water and exposed to putrefaction at about 20° C. with exclusion of air, in time entirely disappears, a large amount of hypoxanthin appearing in its place and likewise a trace of xanthin. In other words, oxygen-free adenin is made by this process to combine with oxygen, being converted into the related oxygen-containing body hypoxanthin, with a giving up of ammonia. Guanin by a like method of treatment is changed into xanthin. The reactions involved are very simple as the following equations show:

$$\underset{\text{Adenin}}{C_5H_5N_5} + H_2O = \underset{\text{Hypoxanthin}}{C_5H_4N_4O} + \underset{\text{Ammonia}}{NH_3}$$

$$\underset{\text{Guanin}}{C_5H_5N_5O} + H_2O = \underset{\text{Xanthin}}{C_5H_4N_4O_2} + \underset{\text{Ammonia}}{NH_3}$$

We thus have every reason for believing that when hypoxanthin results from the breaking down of nuclein it passes through the intermediate stage of adenin. In other words, adenin is a primary cleavage product of nuclein, or rather of nucleic acid, while hypoxanthin is a secondary product coming directly from the adenin. In a similar manner, guanin is a primary decomposition product of nucleic acid, xanthin being in the same sense a secondary product. These four bases are plainly closely related and intimately associated in many ways, and all are alike cleavage products of the nuclein obtainable from cell nuclei. But the primary bodies adenin and guanin are evidently far more susceptible to the changes going on in living cells than their neighbors hypoxanthin and xanthin. All four, however, are capable of complete decomposition with formation of a variety of decompo-

[17] Zeitschrift für Physiologische Chemie. Band 13, p. 432.

sition products. In this connection, one of the most instructive series of changes adenin undergoes outside the body is that induced by long-continued warming with dilute hydrochloric acid, in which it is completely broken down into ammonia, carbonic acid, formic acid and glycocoll or amido-acetic acid. Xanthin and hypoxanthin furnish the same products by like treatment:

$C_5H_5N_5 + 8H_2O = 4NH_3 + CO_2 + 2H\text{-}COOH + CH_2\text{-}NH_2\text{-}COOH$
Adenin. Formic Acid. Glycocoll.

$C_5H_4N_4O + 7H_2O = 4NH_3 + CO_2 + 2H\text{-}COOH + CH_2\text{-}NH_2\text{-}COOH$
Hypoxanthin.

$C_5H_4N_4O_2 + 6H_2O = 3NH_3 + 2CO_2 + H\text{-}COOH + CH_2NH_2\text{-}COOH$
Xanthin.

Again, adenin can be easily decomposed completely into carbonic acid and ammonia, but the most striking fact in connection with this body, as already stated, is its easy convertibility into cyanide of potash, indicating as it does the close relationship existing between this substance and the cyanogen group.

In attempting to ascribe a function to adenin that shall correspond to the accepted function of the cell nucleus, we must have proof that this substance, under conditions which obtain in the body can readily pass into new forms easily capable of undergoing reactions. As has been shown by experiment, the conditions for vigorous reduction processes are present in every cell. Reduction gives a blow by which the oxygen-free adenin may be transformed into a new body having a strong avidity for oxygen, and which may in turn be transformed through the laying on of more molecules into a body resembling, if not identical with, azulminic acid. Adenin, for example, dissolved in dilute hydrochloric acid and treated with zinc is quickly decomposed by the reducing action of the nascent hydrogen evolved into what is evidently azulminic acid $C_4H_5N_5O$, a derivative of dicyan. If dicyan $\begin{matrix} CN \\ | \\ CN \end{matrix}$

is simply dissolved in water and allowed to stand exposed to the air for a long time, the solution gradually becomes dark in color, accompanied by a dissociation in which formic acid, prussic acid, oxalate of ammonia and urea result, together with a certain amount of azulminic acid ; reactions which again emphasize the cyanogen-like character of the adenin molecule.

Such being the nature of adenin, it is not to be doubted that bodies emanating from this substance with strong affinities must be important actors in the physiological and chemical processes, especially those of a synthetical order, going on in all cellular tissues. In this connection it is to be remembered that Pflüger on purely theoretical grounds ascribed great importance to the physological rôle played by the cyanogen group with polymerization, etc., in the living albumin molecule. Dead albumin, such as we see in the white of egg, blood-fibrin, etc., is a comparatively stable substance, indifferent to neutral oxygen, not readily prone to change, and yielding decomposition products by no means identical with the cyanogen-like bodies resulting from normal proteid metabolism.[18] Evidently then the dead food-albumin in being assimilated is reconstructed on a different plan, the atoms are rearranged and in the living albumin molecule, as in the protoplasm of the cell, we are lad to infer a close union of the carbon and nitrogen with formation of the comparatively unstable cyanogen group. In the dead protoplasm, on the other hand, the nitrogen of the proteid is joined directly with hydrogen to form amidogen (NH_2), but in the processes of anabolism going on in all living cells, the nitrogen is detached from the hydrogen and made to combine more directly with carbon to form the more unstable group CN. As a result, the katabolic products of proteid metabolism known to us are the cyanogen-containing bodies, guanin, uric acid, creatin and the related body urea. These are products of the katabolism of living protoplasm, and in the discovery of adenin and its close relationship to the typical xanthin bases we have added proof of the existence of cyanogen-containing radicals in the protoplasm of the cell, especially in the karyoplasm of the nucleus. In all of these xanthin

[18] See Drechsel, however, Der Abban der Eiweissstoffe. Du Bois Reymond's Archiv, 1891, p. 248.

bodies there is to be seen a peculiar combination of carbon, nitrogen and hydrogen such as is not found in dead proteid matter. The structure of the molecule is different and is emblematical of a still more complex molecule in which the atoms are similarly arranged.

Thus, it is to be remembered that whenever an organ rich in cells is decomposed by dilute acid, adenin, guanin, xanthin and hypoxanthin are never obtained alone. They are not found as individuals, but in every tissue which has retained its original condition, the two special xanthin bases, for example, are found in combination with other groups of atoms, especially with phosphoric acid and albumin, as parts of a higher compound, the nuclein. From this higher compound, the individual components cannot be extracted by simple solvents or other like methods of isolation; a blow must be struck by which the complex molecule shall be shattered and the individual parts liberated, as by the action of a dilute mineral acid. In tissues very poor in nuclear elements, on the other hand, as in muscle tissue, we find only the decomposition products of nuclein; the chemical union between the individual fragments is broken, and the phosphoric acid, for example, no longer exists in organic combination, but as soluble alkali phosphates. In a similar manner, the xanthin and hypoxanthin exist in a free condition capable of extraction by water alone.

Further, in the transformation of adenin and guanin into hypoxanthin and xanthin respectively, with a splitting off of the NH group and the acquisition of oxygen we have a possible illustration of the manner in which the migration of the amidogen group of albumin to urea takes place; a transformation which no doubt goes on in the tissues and perhaps in every cell nucleus.

Certainly then in the light of what has been said, the cell nucleus may be looked upon as in some manner standing in close relation to those processes which have to do with the formation of organic substances. Whatever other functions it may possess, it evidently, through the inherent qualities of the bodies entering into its composition, has a controlling

power over the metabolic processes going on in the cell, modifying and regulating the nutritional changes.[19] And you will notice that I lay great stress upon the chemical nature of the karyoplasm, the inherent qualities of the plasm as indicated by its molecular condition. It is not the mere fact that the karyoplasm is housed, so to speak, in a certain definite structure that it is possessed of its characteristic qualities, but the qualities are peculiar to the living molecules themselves. The living molecules are different from the dead molecules because they have a different chemical constitution, the atoms are arranged in a different manner. All this being true we can easily see how cells devoid of specific nuclei may perhaps be functionally active, to a slight extent, provided they contain the same chemical groups in the cytoplasm.

But I have already exceeded the alloted time, while there is much that might be said. Still, the foregoing will indicate in a limited way that there is a field of work in connection with the chemistry of the cell that cannot consistently be ignored in biological inquiries.

[19] Compare M. Verworn, "Die physiologische Bedeutung des Zellkerns." Pflüger's Archiv f. Physiol. Band 51, p. 1.

THE CLASSIFICATION OF THE ARTHROPODA.

By J. S. Kingsley.

In the concluding section of my paper on the Embryology of Limulus ('93), I expressed my views upon the classification of the Arthropods. The following is to be regarded as an expansion of the remarks I then made, with the inclusion of some matter not then available.

Since the days of von Siebold ('46), the naturalness of the group of Arthropoda has been almost universally recognized, only a few, like the present writer ('83) and von Kennel in his recent text-book of Zoology ('93), appearing to doubt the homogeneity of the division. On the other hand, the way in which the Arthropoda should be subdivided has been very differently regarded by different authors. Space will not permit an extended résumé of the growth of our knowledge, but it is fair to say that almost every person treating of the subject has added materially to the basis for a natural classification, either by the discovery of new facts or by throwing new light upon facts known before. At present, the great majority of naturalists divide the Arthropod phylum into two groups or sub-phyla, which, however named, are essentially Branchiata and Tracheata, the former embracing the Trilobites, Eurypterids, Hemiaspids and Xiphosures, along with the true Crustacea; the latter containing the Onychophora (Peripatus) Myriapods, Hexapods and Arachnids.

Yet this division is not universally accepted, and a few years ago, Professor E. Ray Lankester, following out the earlier suggestion of Strauss-Dürckheim and the later one of the younger van Beneden ('71), demonstrated that the affinities of Limulus were with the the Arachnids rather than with the Crustacea. This epoch-making paper—"Limulus an Arachnid"—must form the basis of all farther studies of Arthropod taxonomy, since it logically follows from his conclusions that the distinctions made between Branchiata and Tracheata are physiologi-

cal rather than morphological, and that their emphasis tends to obscure true relationships upon which alone a natural system can be based. Since Lankester wrote, most students of Arachnid morphology and every one (excepting Professor Packard) who has investigated the structure or ontogeny of Limulus, have endorsed the general conclusion that Limulus is closely related to the Arachnids.

This being the case, Lankesters's later views upon the subdivision of the Arthropoda possess a peculiar interest. In the ninth edition of the Encyclopedia Britannica, article "Zoology," he gives the following arrangement:

Branch Arthropoda.
- Grade 1, Ceratophora.
  - Class I, Peripatidea.
  - Class II, Myriapoda.
  - Class III, Hexapoda.
- Grade 2, Acerata.
  - Class I, Crustacea.
  - Class II, Arachnida.
  - Class III, Pantopoda,
  - Class IV, Tardigrada.
  - Class V, Linguatulina.

Professor Claus is apparently not so radical in his ideas. I fail to make out from his various polemical articles ('86 [a, b]., 87 [a]) exactly what his later views are, but in the fourth edition of his Lehrbuch ('88)—the fifth edition is not at hand—there is such a lack of regularity in the subordination of type, headings, etc., that it is difficult to ascertain his opinions. As I interpret him, he has the following scheme:

Arthropoda.
- Class 1, Crustacea.
  - Sub-Class I, Entomostraca.
  - Sub-Class II, Malacostraca.
  - Gigantostraca.
    - Merostomata.
    - Xiphosura.
- Class II, Arachnoida.
- Class III, Onychophora.

Class IV, Myriapoda.
Class V, Hexapoda.

From this it would seem that the only conclusions which can be drawn are that, at least at this date, Professor Claus regarded the Gigantostraca as a subdivision of the Crustacea, but was uncertain whether to regard it as equivalent to the Entomostraca and Malacostraca or not.

It is impossible to give the views of Hatschek, as the part of his " Zoologie " treating of the Arthropods has not yet appeared. In his general table ('88, p. 40) he accepts, in a modified way, the Articulata of Cuvier, and regards the Onychophora as a class, of equal rank with the Arthropoda.

The earlier studies of Boas upon the classification of the Crustacea possess such value that his general ideas upon the subdivisions of the Arthropoda deserve mention. In his " Zoologie " ('90) he adopts the following arrangement:

Arthropoda.
I Class, Crustacea.
I Sub-Class Entomostraca, including as Orders: I, Phyllopoda; II, Cladocera; III, Xiphura (*sic*); IV, Trilobitæ; V, Ostracoda; VI, Copepoda; VII, Cirripedia.
II Sub-Class, Malacostraca.
II Class, Myriapoda.
(Peripatus doubtful.)
III Class, Insecta.
IV Class, Arachnida.

Lang ('88) has the following classification:

Arthropoda.
I Sub-Phylum, Branchiata.
Only class Crustacea.
First "Anhang to Branchiata—Trilobita, Gigantostraca, Hemiaspidæ, and Xiphosura.
Second "Anhang"—Pantopoda.
II Sub-Phylum, Tracheata.
I Class, Protracheata.
II Class, Antennata (Myriapoda and Hexapoda).
III Class, Chelicerotæ *sive* Arachnoidea.
"Anhang" to Arthropoda—Tardigrada.

Fernald has approached the subject from the standpoint of Hexapod morphology. He gives ('90) a phylogenetic tree in which two main trunks arise from the primitive unsegmented worm. One of these embraces the Annelids and Peripatus, the other includes the Arthropods proper. This latter branches into the Hexapods and the Crustacea, the Arachnids and Limulus being represented as offshoots from the main Crustacean line. The origin of the Myriapods is left in doubt, but of the two divisions the Chilopods are represented as an offshoot from the Diplopod stem.

Richard Hertwig ('92) adopts the following scheme:

Branch Arthropoda.

- I Sub-Phylum, I Class, Crustacea.
  - 1 Sub-Class, Entomostraca, containg as regular members the Orders: I, Copepoda; II, Branchiopoda; III, Ostracoda; IV, Cirripedia; and, as "Anhangen," V, Xiphosura; VI, Trilobitæ; VII, Gigantostraca.
  - II Sub-Class, Malacostraca.
- II Class, Onychophora.
- III Class, Myriapoda.
- IV Class, Arachnoida (including Pantopoda as an "Anhang").
- V Class, Hexapoda.

Lastly, von Kennel, whose studies on Peripatus entitle his views on Arthropod taxonomy to a hearing, denies ('93) the validity of the group Arthropoda, claiming that those features which would seem to unite the Tracheata and Branchiata are either superficial or are common to the whole series of metameric Invertebrata. He places the Xiphosura among the Crustacea, apparently regarding them as equivalent to the rest of the group. The Tracheata are divided into three sub-classes, Myriapoda, Hexapoda and Arachnoida, the relationships of Tardigrada and the Pycnogonida being regarded as uncertain.

My own views, as stated in my last paper on Limulus, have not undergone any extensive modification, although the tabular statement has undergone some slight changes. Chief of these is the transfer of the Trilobitæ from a position of uncertainity to a more close union with the true Crustacea, a matter

which will be referred to again below. I would now present the following scheme:

Phylum Arthropoda.
  Sub-Phylum I, Branchiata.
    Class I, Crustacea.
      Sub-Class I, Trilobitæ.
      Sub-Class, II, Eucrustacea.
    Class II, Acerata.
      Sub-Class I, Gigantostraca.
      Sub-Class II, Arachnida.
  Sub-Phylum II, Insecta.
    Class I, Chilopoda.
    Class II, Hexapoda.
  Sub-Phylum III, Diplopoda.
Incertæ Sedes—
  Pycnogonida.
  Linguatulina.
  Pauropoda.
  Tardigrada.
  Malacopoda.

The various papers by Lankester, McLeod, Laurie and myself have, I think, clearly shown that the older grouping of the Arthropoda into Branchiates and Tracheates is not justified by the facts of structure and ontogeny; that tracheæ are not homologous structures in all Arthropods which possess them, and that the old group of Tracheata is polyphyletic in origin. Since classification must represent the various lines of descent, the old must therefore go. There remain many points which must be investigated anew, but I feel confident that further research will support, in its main features, the classification adopted above, and considered more *in extenso* below.

PHYLUM ARTHROPODA.

I am not prepared to discuss the validity of this group, although for reasons that will appear below, I am inclined to believe the great divisions which I recognize are but remotely related to one another, and it may yet be proved, as I suggested several years ago ('83), and as von Kennel believes, that

they have no common ancestor nearer than the Annelids. The jointed nature of the appendages offers no insuperable objection to this view, while the early phases of the egg, the formation of the germ layers, the structure of the alimentary canal, the morphology of the reproductive and excretory organs, as well as certain facts concerning the circulatory, respiratory and nervous systems are easiest explained upon such an hypothesis. The presence of compound eyes in branchiate and tracheate forms would, at first thought, be a strong argument for the older views, but these organs differ so greatly in their structure that it is easier to regard them as homoplastic organs (comparable in a way to the eyes of Cephalopods and Vertebrates) rather than as derivatives from a common compound ancestral visual organ. For our present purposes, the group of Arthropoda may be retained as a convenient assemblage, characterized in the following manner: Heteronomously segmented animals, with, typically, a pair of appendages to each somite; the whole enclosed in a chitinous segmented exoskeleton, the jointing of which extends to the appendages, thus justifying the term Arthropoda. The appendages, primitively locomotor in function, may be modified, on one or more somites, for the taking or commuting of food, for respiration, copulation, oviposition, sensation, fixation, etc. No circular layer of muscles in body wall; nervous system consisting of a pair of primitively supraœsophageal ganglia and a ventral chain of paired ganglia, of which one or more pairs may, in the course of development, be transferred to the prestomial region. Eyes, simple, aggregate, or compound, with, in some cases, an inversion of the retinal layer. Cœlom small, inconspicuous; circulatory organs consisting of a dorsal heart enclosed in a vascular pericardial sac; blood-vessels more or less evidently metameric, terminating in "lacunar" spaces. Respiration, either by the entire surface of the body or by specialized outgrowths or involutions of the same. Excretion, either by true nephridia or by Malpighian tubules, developed from either the mid- or the hind-gut. Reproductive organs consisting of gonads developed from the cœlomic walls and with modified nephridia serving as efferent ducts.

In order that we may compare, part with part, the different forms of Arthropods, it becomes necessary to assume some basis of comparison, and apparently the only one available is that of the exact homology of the similarly situated meta meres in the different groups, but here we meet with a difficulty. How can we be certain, for example, that somite 10 of the lobster is the exact homologue of somite 10 in the beetle? How can we tell that no somite has been lost in the evolution of these different lines? Perfect certainty is impossible, and we now know that in the serial comparisons of not more than five years ago, errors crept in, because there is a tendency of somites to become aborted or obsolete. This tendency is well-known in cases of Apus and Oniscus, where one of the anterior pairs of appendages is greatly reduced; and in Limulus, Scorpions, Moina, etc., where an anterior somite is not differentiated until after those behind it. In many forms there is an obliteration or a fusion of cœlomic cavities in the anterior region, the mesoderm flowing together as a common mass.

On the other hand, the embryonic phases of the nervous system seem to give clear indications of neuromeres in the anterior end of the body, and, as farther back, neuromeres correspond to the mesodermic metameres, it is reasonable to accept until error be shown, a somite for each neuromere at the anterior end of the Arthropod body. Unfortunately, we have detailed knowledge of these neuromeres in but few cases, and even in these there is a lack of uniformity in the observations.

In the Hexapods it has been shown that the "cerebrum" of the adult is composed of at least three pairs of ganglia called by Vaillanes, respectively, the protocerebrum, the deutocerebrum and the tritocerebrum. These elements have been recognized by Tichomiroff in the silkworm (teste Cholodkowsky) in Acilius (Patten, '88), in Blatta (Cholodkowsky, '91), in Mantis (Vaillanes, '91), in Xiphidium and Anurida (Wheeler, '93), while Carrière ('90) has described *four* cerebral elements in Chalicoderma. The figures of the latter author do not seem to me conclusive, and I am inclined to believe the more numerous observations in this difficult field as the more probably correct.

These cerebral elements apparently have different values. So far as observations go, the protocerebrum is always preoral, and in no case is any appendage developed in connection with it. Apparently, the region in which it occurs is to be compared to the preoral lobe of the annelids, while the two ganglia of which it is composed would correspond to the "Scheitelplatte" of German embryologists. The other cerebral elements, on the other hand, are primitively behind the stomodæum, and, in some forms at least, an appendage is developed in connection with each. Thus the antennæ belong to the deutocerebral neuromere, while in Anurida Wheeler has shown that the tritocerebral neuromere possesses at an early stage a pair of small appendages, which here, as in all Hexapods, is absent from the adult.

In the Crustacea, not a few observations go to show somewhat similar conditions. We find there a protocerebrum without appendages at any stage, followed by a series of ganglia which present many claims to belong to the postoral series. In a paper on the Embryology of Crangon ('89), I claimed that in that form the antennæ were primitively postoral, but since the validity of my observations have recently been questioned by Weldon ('92) and Herrick ('92),[1] they must be repeated before they can be accepted. Aside, however, from these questionable observations, there are many other facts which go to show that the antennal neuromeres belong to the the postoral rather than to the prestomial series. There is, however, less evidence for this position for that pair of ganglia which exist in the lobster (see Bumpus ('91), pl. XVII, fig. 1), between the protocerebral ganglia and the neuromeres of the antennæ. It is without appendages, and although its fate has not been traced, it probably becomes fused in the "cerebrum" of the adult.[2] This neuromere is, I am inclined to think, also to be regarded as belonging to the same series as that of the antennæ.

[1] For some remarks upon these criticisms, see my paper ('93), p. 235, foot-note.

[2] Professor J. P. McMurrich informs me that he has found these deutocerebral ganglia in the various Isopods (Jæra, Oniscus, Porcellio, Armadillidium, etc.) which he has studied.

In the Arachnids and the Xiphosures, we have evidence of several elements in the "brain." Both Patten and myself have shown the existence of three pairs of cerebral ganglia in Limulus, in front of the ganglia of the first pair of appendages. Patten finds ('90) the same number in the brain of the Scorpion, as do Locy ('86, pl. XI, fig. 70) and Kishenouyi ('90) in Agalena. The copies of Morin's figures given by Korschelt and Heider ('92, fig. 383 B) seem also to be in full harmony. On the other hand, Schimkewitsch (87, pl. XXI, fig. 3) represents two pairs of ganglia in Epeira in front of the ganglia of the first pair of appendages, while in the diagrammatic figure (pl. XXIII, fig. 5) he apparently indicates four pairs of preappendicular ganglia.

In other groups of Arthropods I know of no detailed observations which can be used to aid in the enumeration of the neuromeres in the anterior region of the body. If we assume that in the cases of Hexapods, Crustacea, Xiphosures and Arachnids, the neuromeres enumerated above represent the total somites in this region, we may then compare, somite by by somite, these groups in the following manner:

	Hexapod.	Arachnid.	Xiphosure.	Crustacea.
Neuromere I	No Appendage	No Appendage	No Appendage	No Appendage
" II	Antenna	No Appendage	No Appendage	No Appendage
" III	Appendage	No Appendage	No Appendage	Antennula
" IV	Mandible	Chelicera	1st Leg	Antenna
" V	Maxilla	Pedipalpus	2d Leg	Mandible
" VI	Labium	1st Leg	3d Leg	Maxilla 1
" VII	1st Leg	2d Leg	4th Leg	Maxilla 2
" VIII	2d Leg	3d Leg	5th Leg	Maxilliped 1
" IX	3d Leg	4th Leg	6th Leg	Maxilliped 2

Of course it will be understood that this grouping is limited by our present knowledge, and that at any time discoveries may be made which will overturn it. It is, however, to be noted that it brings the hinder margins of the thorax of the Hexapoda and of the cephalothorax of Limulus and of the

Arachnids into exact correspondence. In the case of the Crustacea the corresponding line passes behind the third maxilliped of the Decapod.

If it should, however, be shown (as many believe) that the Crustacean metastoma has its own somite, the line will be thrown forward to behind the second maxilliped, and it will correspond to the line of division between the head and thorax of the Edriophthalmia.

Since the older ideas of numerical sequence are better known, I have used them in the following discussion rather than that based upon the neuromeres. Thus in the Hexapods somite (or appendage) I=Neuromere II ; in the Arachnid and Xiphosures somite I = Neuromere IV ; in the Crustacea somite I = Neuromere III.

The morphology of some other organs call for a moments' consideration. Prominent among these are the vasa Malpighii. These are usually regarded as characteristic of the "Tracheates," and their presence in the Arachnids has been adduced as a strong argument for their association with the Hexapods. It has been, however, pretty conclusively shown that these organs are not homologous throughout the Arthropod phylum, for in the Hexapod they are derived from the hind-gut, and are therefore ectodermal, while in the Arachnida, as Loman ('86–7) has shown, they are derivatives of the mesenteron and are consequently entodermal. Their similarities are those of homoplassy rather than of homology, and the only argument that can be drawn from the occurrence in these forms is that Arachnids and Hexapods are not closely related. Similar organs with similar functions have been described in various Edriophthalmia, but we are yet in doubt as to their origin. The studies of Spencer ('85) represent them as without chitinous intima in the Amphipods. They may, therefore, be entodermal. A detailed study of the region of the hind-gut of certain Decapods might give results interesting in this connection.

The tracheæ furnished another instance of homoplassy. These organs furnish the chief ground for the group called "Tracheates," since in most they form the sole means of res-

piration. Yet these are, in the opinion of many, not homologous. In the Hexapoda they arise, ontogenetically, as inpushings of the ectoderm of sides of the body, outside and above the line of the insertion of the limbs. Their method of growth, the general structure, etc., all point to their origin, as was pointed out by Chun ('75) from dermal glands which later assumed respiratory functions. The tracheæ of the Arachnids, on the other hand, have had a different origin. In those forms in which they have been studied, they arise as inpushings behind the temporary appendages on the abdomen. There is not a little evidence to show that they have arisen from gills borne on the posterior surfaces of these appendages, as in the Limulus of to-day; that they have been pushed into the body, taking the form of lung books, a condition permanent in all the respiratory organs of the Scorpions and in those of one or two somites of the Araneina; and then, coincidently with a reduction in the circulatory organs, they have penetrated farther and farther into the body. For the details of this process, as well as for the wonderful histological similarity between the embryonic gills of Limulus and lungs of Arachnids the reader is referred to my full paper. The "spiral threads" in the two cases are to be explained as mechanical in origin—corrugations give greater strength without excessively thickening the intima. Still, a third type of "trachea" is to be be found in the gills of the Oniscid Crustacea. These organs have become adapted for aerial respiration, and, in connection with this change, the organs have been permeated by branches of minute tubes, lined with a chitinous intima, produced by inpushings of the outer body wall. These tracheæ cannot be regarded by the strongest advocate of the naturalness of the "Tracheates" as homologous (*i. e.*, homogenous) with those of the Hexapods. I have made a number of, as yet unpublished, observations on these organs in Porcillio. Leydig described them in detail some years ago ('78). The peculiar structures in the genus Tylos as described by Henri Milne-Edwards ('40, p. 187–8) should be considered in this connection.

It is only recently that the existence of nephridia in the Arthropoda has been placed beyond a doubt. The earlier students

of the shell gland of the Entomostraca often made comparisons between it and the "segmental organs" of the Annelids, but the trouble was that the former terminated blindly internally, while in the Annelids the organ formed a tube connecting the body cavity (cœlom) with the interior. The problem was solved by Sedgwick ('88), who showed that in Peripatus the nephridia were closed internally, but that they were still nephridia as proved by development, and that we have here to deal with a greatly diminished cœlom. In the light of these facts it is now placed beyond a doubt that in the antennal and shell glands of the Crustacea, and in the coxal glands of Arachnids and Limulus, we have true nephridia.[3] In all there is the formation of a cœlom, a division of the cœlom of certain somites into dorsal and ventral moieties, and a development of the lower portion into end sac and nephridial tube, the latter portion breaking through to the exterior.[3]

Following the discoveries by Sedgwick that the genital ducts of Peripatus were modified nephridia, came the observations of Heymons ('90), Cholodkowsky ('91) and Wheeler ('93), all of which show that exactly the same conditions exist in the Hexapods, while Laurie ('90) has demonstrated that it is at least probable that the same holds true for the Scorpions. I made no observations on the origin of the genital ducts of Limulus, and I do not recall any account of their development in the Crustacea. In the latter group, however, there is not a little evidence of an anatomical character which is easiest interpreted upon the same hypothesis. There these ducts are metameric, and may occur in different somites in the different sexes. This condition is to be explained in two ways, as has previously been pointed out by Lankester. Either the ducts are to be regarded as new formations, or they are previously existing structures modified for reproductive functions exclusively. That this latter is the case, and that the ducts are nephridial is rendered probable by the following considera-

[3] These organs have been shown beyond a doubt to be mesodermal by Grobben ('79), Kingsley ('89, '90 and '93), Kishenouyi ('91), Lebedinsky ('92), Laurie ('90), etc., and yet Bernard ('93), with these facts available, has recently attempted to derive these structures from the glands of annelids—ectodermal structures—ignoring the facts presented by those who have actually investigated the subject.

tions: In all metameric animals one or more pairs of nephridia serve as genital ducts, and no case is known of the formation of new outlets. The genital ducts are so related to the gonads and these latter to the cœlom, at least in the Decapods (*cf.* Weldon, '89, '91) that we must regard the genital epithelium as cœlomic, and the ducts as ventral diverticula of the same space.

The salivary glands afford some difficulties, for they occur in most "Tracheates," and are usually stated to be absent from the "Branchiates." This apparent difference between the two groups is possibly to be explained by the different method of life—aquatic in the latter, terrestrial in the former. It is, however, to be noted that salivary glands have been recognized in Astacus (*cf.* Lang, '89, p. 344), while renewed studies must be made of the so-called salivary glands of the Arachnida before we are certain of their homology with those of the Hexapods. Several organs which have been called salivary glands among the spiders and their allies have been shown to be coxal glands (*i.e.* nephridia) or poison glands, and it is possible that all of these organs may have different homologies than those indicated by the name usually applied to them.

A group of structures which cannot, as yet, be discussed, is that of the embryonic membranes. In the Scorpions as in the Hexapods, the embryo develops those as yet unexplained fœtal membranes which so closely simulate those of the higher vertebrates. It may be that here, as in other places, we have similar but not identical organs. The accounts of their development in the Arachnids by Metschnikoff, Kowalevsky and Schulgin, and Laurie differ considerably, and, until we know something of the ancestry and real meaning of the structures which are united under this head we cannot be certain of the taxonomic value to be placed upon them. It may be noted here that the structures described by Bruce ('87) as occurring in the spiders are, in all probability, not amnion and serosa, but either invaginations in connection with the brain or the inpushing to form the median eye.

SUB-PHYLUM I—BRANCHIATA.

Arthropods breathing by means of gills (or lungs or tracheæ modified from gills) developed in connection with the appendages; without distinctly differentiated head, with long stomodæum, nephridia persisting in somite II or V (or both), genital ducts opening near the middle of the body. Anterior appendages all multiarticulate, the basal joints of one or more pairs serving as organs of manducation. A chitinous entosternite and deutova frequently present.

I hardly think it necessary, each time the limits of a group are changed, to give the new combination a new name. Our nomenclature is already cumbersome enough, and the slight indefiniteness is vastly preferable to the confusion of the other course. I have, therefore, retained the term Branchiata for the enlarged group, since I regard the lungs and tracheæ of the Arachnids as but modified branchiæ. In only the Edriophthalmia and certain Phyllopods do we have a distinctly differentiated "head," and the head in these groups is not the same in its limits. Under the head of nephridia I include the antennal and shell glands of the Crustacea and the coxal glands of the Arachnids and Limulus. The former have been shown by numerous observers to be true nephridia, while the observations of Laurie ('90) and Lebedinsky ('92), Sturanay ('91), are conclusive to the Arachnids. The observations of Gulland ('85), Kishenouyi ('91) and myself ('85 and '93) would seem to settle the matter in the Horse-shoe crab.[4] That the genital ducts are to be regarded as modified Nephridia has already been shown. Their position is inconstant in the Crustacea, varying in some forms with the sexes of the same species. In some of the more reduced forms, as the cirripeds, they are apparently almost terminal, a condition to be explained by the

[4] In my first paper on the development of Limulus, I pointed out that the coxal glands of Scorpio and Limulus were apparently homologous with the shell gland of the lower Crustacea, since in both cases they open at the base of the fifth pair of appendages. This identification is apparently not pleasing to Professor Claus ('86), since he has seen fit to ridicule my ideas of homology. I confess that I do not understand his objections, and certainly the evidence derived from the neuromeres (admitting one for metastoma of the Crustacea—*cf.* Brooks, '82), seems fully to support my thesis.

small number of metameres that become differentiated. Other features which are common to most Branchiates, but which either are not common to all or are at the same time common to some of other groups, will appear below. It must, of course, be understood that in the above diagnosis of the group, features of internal anatomy are known only of recent forms; of the visceral structure of the trilobites, we are absolutely in the dark.

Class I—Crustacea.

Branchiate Arthropoda with functional gills; with one or two pairs of distinctly preoral appendages (antennæ) the first being purely sensory; the ganglia corresponding to these appendages being fused with the protocerebrum to form the "brain;" the appendages with typically a basal joint giving rise to two or three branches; several pairs of appendages modified for eating; alimentary canal with long œsophagus and well-developed stomodeal "stomach," mid-gut region short, the mid-gut glands ("liver") being well-developed; proctodeum long.

In all living Crustacea (Eucrustacea), there are two pairs of antennæ, although in some forms (e. g., Apus, Oniscids) one or the other pair has has become greatly reduced. In the Trilobites, on the other hand, but a single pair has, as yet, been discovered. It therefore remains to be shown whether a single pair is characteristic of these forms, or whether we have here a possibly greatly reduced additional pair. In case the former alternative prove true, it may be necessary to remove the Trilobites completely from the position here assigned them, though it will not necessarily follow that they should be associated with the Eurypterids and Limulus. (For the position of the Trilobites, see below).

It is difficult to say exactly what weight should be given the so-called "typical Crustacean limb," the di- or trichotomous appendage so frequently met with in this class, and which is not infrequently regarded as diagnostic. That this condition is a derivation of the lamellate condition found in Apus, as maintained by Lankester ('81) admits of little doubt, and

hardly more doubtful is the view which would compare the Phyllopod appendage with the Annelid parapodium. But two- and three-branched appendages are not unknown outside the Crustacea. One of the arguments advanced in favor of a Crustacean position for Limulus is that the abdominal appendages in that form are two-branched, while numerous observers have recorded a biramous condition in the appendages of the young of various "Tracheates." Among others we would mention the biramous pedipalps in Dendryphantes recorded by Croneberg ('80), the biflagellate antenna of an Indian Lepisma, and of an embryo *Blatta javanica* by Wood-Mason ('79), the bifid condition of the antenna of Blatta by Wheeler ('89), while Patten ('84), in the same form, describes the maxillæ and labium as "formed respectively of two and three branches, the second maxillæ thus attaining the typical trichotomous structure of the Crustacean appendages." Similar observations have been made upon other Hexapods, while in the Pauropida the trichotomous antennæ are to be called to mind.

Fully as characteristic is the extreme reduction of the entodermal portion of the alimentary canal proper, the entoderm cells being largely confined to the liver or mid-gut gland, while the canal itself is almost entirely composed of stomodeal and proctodeal invaginations (*cf* Kingsley, '89, pp. 13-19).

Sub-Class I—Trilobitæ or Palæocarida.[5]

Fossil Crustacea with tri-regional body—head, thorax, pygidium, all bearing appendages. "Head" unsegmented, with one pair of antennæ and with four pairs of postoral appendages, all pediform and with basal points manducatory. Thoracic somites indefinite in number, each bearing a pair of biramous (exopodite and endopodite) appendages, each appendage provided with a straight or curiously coiled gill (?). Pygidium segmented, with appendages beneath.

For several years I have maintained that the Trilobites had but the most distant affinities with the Xiphosures (e. g., '85, p. 555).

[5] This term was introduced by Packard ('79) for Limulus, the Trilobites and the Eurypterids. Later ('86), with no apparent reason, he dropped this term and substituted for it Podostomata. The two groups, as he limits them, are exactly the same.

In my latest paper ('93, pp. 252–254) I repeated the same ideas, and, within a short time of this paper, appeared Mr. Matthew's notice ('93) of the existence of true Crustacean antennæ in these forms. This, combined with the truly Crustacean thoracic appendages already described by Wolcott ('81 and' 84), and the utter inability, upon careful analysis, to homologise the regions in Limulus and the Trilobites, is sufficient to divorce the two and to assign the latter to the Crustacea.

Exactly what position they should occupy here is uncertain. It is undeniable that they present a superficial resemblance to the Isopoda. In both there is the same depressed body, the division of this into the three regions of head, thorax and abdomen, the head in both cases bearing sessile compound eyes; but at this point the resemblance ceases. In the Isopod the thorax is always 7-jointed; in the the Trilobites the number varies very considerably. In the Trilobites the appendages, as restored by Walcott, surround the mouth, much as in Limulus or the Scorpions; in the Isopods the arrangement is truly Crustacean. In the Isopods, in the embryo, as well as in the adult, the thoracic appendages consist of but a single branch, and when any other structures are present, as for instance, the plates forming the brood-pouch, these are placed mediad to the insertion of the limb; the gills (?) in the Trilobites are outside the point of articulation, while the limbs, as already stated, are dichotomously branched. In the Isopods the respiratory organs are lamellar appendicular plates beneath the abdomen; we do not know exactly what structures are found here in the Trilobites. Professor Mickleborough ('83) thinks that there are lamellar plates, but Mr. Walcott ('84) studying the same specimens believes that the appendages of this region resemble those of the thorax.[6] So it would appear that the Trilobites have no close affinities with the Isopoda; the resemblances to the Amphipods are even less close. So far as I am aware, there is no recent Crustacean which presents any resemblance to Trilobites closer than those of the Edrophthalmia just discussed, and yet we

[6] The process cuts illustrating Mr. Matthew's article gives no intelligible details of the foot structure in Triarthrus.

must consider these forms considerably removed from the primitive Crustacean stock, which, in the opinion of many, was not far removed from the modern Phyllopoda. Both types are well differentiated in the lower Cambrian, and no fossils as yet discovered serve to bridge the gap between the two. Nor does the little known of Trilobitan embryology throw any light upon the question. In some there is an apparent close similarity to the early stages of Limulus, but this may easily be explained upon the general principles of Arthropod growth. Thus, in Sao, as described by Barrande ('52), in which the resemblance to the Xiphosures is most marked, we have but that increase in the number of somites from a posterior budding zone common to most Arthropods, while in Trinucleus (Barrande) there seems to have been an acceleration in the development of cephalic and pygidial regions, and then, later, an increase in the number of thoracic segments in that manner so familiar in the development of the Decapoda. The resemblances to Limulus all lie in the depressed body form and the union of the anterior somites.

(*To be continued.*)

THE RANGE OF CROSSBILLS IN THE OHIO VALLEY WITH NOTES ON THEIR UNUSUAL OCCURRENCE IN SUMMER.

By A. W. Butler.

Loxia curvirostra COMMON CROSSBILL.

In 1838, Dr. Kirtland had not met with the American Crossbill (*Loxia curvirostra minor*) in Ohio or Indiana. Dr. Haymond omitted it from his "Birds of southeastern Indiana" in 1856. Dr. Wheaton reported it from Ohio in the winter of 1859–60. Evidently it was quite well known to Dr. Haymond in 1869. The winter of 1868–9, they were very abundant in the vicinity of Cincinnati (Dury). This was doubtless the case at other places also. The range of the species at this time was supposed to be northern North America, south in the Appalachian Mountains into Pennsylvania, extending in winter, irregularly over much of the United States. A letter from Mr. C. E. Aiken of Salt Lake City, Utah, informs me that this species became very abundant in the city of Chicago in July and August 1869, and remained until late in the fall. They fed greedily upon seeds of sunflowers and were so sluggish that one could approach within a few feet of them, so that they fell an easy prey to boys with catapaults. In the latter part of August of the same year, he found them common in Lake County, Indiana. He also notes that they were not rare the succeeding year in the vicinity of Chicago.

Dr. F. W. Langdon notes the capture of a single specimen from a flock of six or eight at Madisonville, near Cincinnati, Ohio, Nov. 30, 1874.

In the winter of 1874–5, Mr. Eugene P. Bicknell noted these birds were present in the lower Hudson Valley, and in April of the latter year found their nest. In the same article is noticed the occurrence of the species about New York City in late spring and early summer, on Long Island in midsummer, and on the Bermudas from March to May (Bull. Nutt. Orn. Club, Vol. V, pp. 7–11). Mr. E. W. Nelson in his paper on "Birds of northeastern Illinois," read before the Essex Insti-

tute, December 4, 1876, says it was "formerly a common winter resident, now rare." Messrs. Dury and Freeman (Journ. Cin. Soc. Nat. Hist., 1879, p. 4) note its occurrence at Westwood, Ohio, in 1879. Dr. J. M. Wheaton (Bull. Nutt. Orn. Club, 1879, p. 62) gives the following account of the occurrence of the species in Ohio:—"On the 18th of June last, Mr. Charles Hinman killed one of these birds out of a flock of eight or ten which visited the coniferous trees in his garden in this city (Columbus). The specimen which came into my possession by the kindness of Mr. Oliver Davie was a male, not in full plumage. I have since learned that the Red Crossbill has remained during the season in the vicinity of Cleveland in considerable numbers, and is reported to have nested there." In commenting on this note (Ohio Geol. Survey, Vol. IV, Zoology and Botany, p. 317) Dr. Wheaton says:—"I was unable to learn whether its nest had been actually discovered," and adds "It has been known to nest in Indiana within a few years." I regret very much that I have been unable to get any clue whatever to the authority upon which the statement is made. Professor A. J. Cook in writing of the The Birds of Michigan says of the American Crossbill "Occasional in summer." Dr. H. A. Atkins took nests of this species at Locke, July 13. 1880. It had previously been reported as breeding in Minnesota.

In July and August, 1880, they were noted at Rugby, Tenn. (The Oologist, Vol. V, pp. 78–9; Bull. Nutt. Orn. Club, Vol. VI, pp. 56–7). Dr. C. Hart Merriam notes it as an "abundant resident" in the Adirondack Region. He says it is "rather scarce and irregular in summer, but the commonest bird in winter and early spring. Breeds in February and March while the snow is still four or five feet deep on the level and the temperature below zero (Fahr.), Have taken fully fledged young in April" (Bull. Nutt. Orn. Club, Vol. VI, p. 229).

Mr. C. W. Beckham (Birds of Nelson County, Kentucky; Ky. Geol. Surv., p. 24) says:—"A flock of six or eight of these birds appeared here on Nov. 18, 1882, in some pine trees, the first time I had ever observed them. They remained only a

day or two, and none were seen until the 17th of March, following, when I shot eight out of a flock of about twenty in the same place where they had previously been seen. Several flocks were observed about the same time near Bloomfield and Glenville in this county, and excited considerable comment on account of their queer bills. The weather at the time was quite mild, so that their appearance here was probably due to some other cause."

The winter of 1882–3, they were unusually abundant in many localities between the great lakes and the Ohio River.

Professor B. W. Evermann first observed them at Bloomington, Indiana, Feb. 10, 1893. This was the second record for the state. For some time after they were common in Monroe County. March 15, 1883, Mr. E. R. Quick reported having seen a single specimen near Brookville, Indiana. April 2, my attention was attracted to a peculiar crackling sound which came from among the pine trees in my yard at Brookville. Close investigation revealed the fact that the cause was a lot of Crossbills. They were shelling the seeds out of the pine cones, and the breaking of the cones made the sound which attracted my attention. I observed others were upon the ground feeding upon the seeds in the fallen cones. April 3, I saw six more in my yard. April 4, I saw one in a flock of Pine Finches. April 5, Mr. Quick noted one. Of those observed, but one was in the red plumage. Professor B. W. Evermann saw a few at Delphi, Carroll County, Indiana, the middle of March, 1883. At the same place about twelve were seen Dec. 26, 1884. Mr. J. W. Byrkit informs me that they were very abundant at Michigan City, Indiana, in the winter of 1883–4. Miss H. E. Colfax in her report of the birds noted at the lighthouse at the same place, gives it Jan. 16, 1884. In the winter of 1883–4, Professor Evermann reported them very common in Monroe County, Indiana.

The Ornithologist and Oologist, Vol. VIII, p. 68, contains an account by A. H. Helme of their breeding April 10, 1883, near Miller's Point. L. I. Mr. Robert Ridgway (The Auk, Vol. I, p. 292) notes the probable breeding of the Red Crossbill in central Maryland in May, 1884. Mr. F. C. Brown

reported their breeding in eastern Massachusetts in the summer of 1884 (The Auk, Vol. II, p. 105). In the winter of 1884–5, they were tolerably common in Monroe County, Indiana (Blatchley in Hoosier Naturalist, 1886, p. 170). The late Mr. C. H. Bollman noted them "quite common" in the same county through March, April and early May, 1885. He saw them first March 2 and last observed them May 12. Mr. J. W Byrkit informed me that he saw the first Crossbills for the year, March 24, 1885. He adds "I am not quite positive, but I think the Crossbills breed, here (Michigan City) as they make their appearance about this time and leave for the north about the middle of May." Mr. Charles Dury informed me they were abundant at Michigan City, Indiana, one winter, which he thinks was 1885. He also reported Pine Finches and Redpolls from the same locality the same year. Professor B. W. Evermann reported it from Carroll County, Indiana, March 27, 1885. I am indebted to Mr. E. M. Kindle for the information that Mr. Sam. Hunter reported a pair of American Crossbills as having bred at Bloomington, Indiana, in 1885. Mr. Hunter informed him they nested in a pine tree and that the nest was made exclusively of pine burrs. Mr. R. R. Moffitt informs me that Red Crossbills were taken in Tippecanoe County, Indiana, in 1885. He says they nested there. Professor B. W. Evermann noted them at Camden, Indiana, March 27 and April 13, 1885, also a large flock at Burlington, Indiana, April 23, 1885.

Mr. Wm. Brester reported its occurrence in the mountains of western North Carolina in the summer of 1885 (The Auk, Vol. III, p. 107) and says:—"Seen only on the Black Mountains where it was numerous in small flocks throughout the balsam forests above 5,000 feet." At Highlands I was told that it regularly appeared in winter about the outskirts of the town. Mr. Charles W. Richmond (The Auk, Vol. V, p. 22) gives upon the authority of Mr. Hugh M. Smith, the information that an adult male American Crossbill, accompanied by a young bird, was seen May 17, 1885, within the District of Columbia.

Professor L. L. Dyche reports the occurrence, in the winter of 1885–6, of the western Red Crossbill, *Loxia curvirostra stricklandi*, at Lawrence, Emporia, Manhattan and Wakarusa, Kansas. They were first observed Nov. 1, 1885, and were last seen Jan. 26, 1886 (The Auk, Vol. III, pp. 258–261). The following winter I was fortunate in securing through the kindness of Mr. A. O. Garrett, a series of specimens of *Loxia curvirostra minor* from Lawrence, Kansas. March 13 and 14, 1887, he obtained four which he sent me, and later he sent me nine others which were taken March 24 and 25. The meeting of the range of these two forms is of considerable interest.

Professor B. W. Evermann reports a Crossbill species not determined from Bloomington, Indiana, Feb. 23, 1886, and another March 8, 1886. The same authority states the late Mr. C. H. Bollman found a few specimens of the Red Crossbill near Bloomington, Indiana, July 10, 13 and 14, 1886. It was found in the White Mountains, N. H. (The Auk, Vol. IV, p. 105). Mr. George B. Sennett, in the same volume, p. 242, gives an account of finding this species in the mountains on the borders of North Carolina and Tennessee in July and August, 1886. Mr. Arthur T. Wayne, in the same volume pp. 287–289, notes their abundance near Yemassee, S. C., in Nov. and Dec., 1886 and in Jan. and Feb., 1887. He noted them again in the same vicinity Nov. 20, 1887 (The Auk, Vol. V, p. 115), also during Jan., 1888 (Ibid, p. 208). Mr. Frank M. Chapman also reports them from Aiken, S. C., Nov. 12, 1887, (Ibid, p. 324). Mr. G. G. Williamson observed them in Monroe County, Indiana, Jan. 18 and Feb. 6, 1886. Mr. J. G. Parker reports them from Lake County, Indiana, in May, 1887. In fall of 1887, I again observed them at Brookville, Indiana. They came to feed upon the pines in my yard. Oct. 29, several were seen and they last appeared Nov. 19. Professor Walter Faxon and Dr. J. A. Allen give it as common in the White Mountains, N. H., in July, 1874, June, 1885 and June, 1886 (The Auk, Vol. V, p. 152). Dr. J. A. Allen on the next page of the same number of "The Auk" speaks of a pair of American Crossbills taken at Mandeville, La., March 27, 1888. Professor B. W. Evermann found them in Vigo County,

Indiana, in the spring of 1888. They were first seen Feb. 6 and disappeared May 6. Mr. J. O. Snyder found them at Waterloo, Indiana, March 13 and 17, 1888. Mr. H. N. McCoy informed me they were quite common in Wayne County, Indiana, in the early part of 1888. They were last seen April 5. Mr. G. G. Williamson saw six or eight individuals near Muncie, Indiana, April 17, 1888; May 4, he saw three others.

Mr. Otho C. Poling notes their occurrence in Adams County, Ills. He gives no account of their occurrence in summer (The Auk, Vol. VII, p. 239). Mr. John A. Balmer informs me these Crossbills were found in the vicinity of Vincennes, Indiana, in the winter of 1888–9. Mr. J. F. Clearwaters told me of the capture of two of these birds in Putnam County, Indiana, in the winter of 1888. A flock of American Crossbills was seen by Mr. J. O. Snyder at Waterloo, Indiana, April 27, 1889. Mr. Stewart E. White informs me he found them common on Mackinack Island, Michigan, Aug. 3 to Aug. 9, 1889. Mr. H. W. McBride wrote me of taking three specimens at Waterloo, Indiana, April 2, 1890. Feb. 14, 1891. Mr. Stewart E. White saw six at Grand Rapids, Mich. He next noted the species March 16. He says it is quite rare in that vicinity. Mr. J. F. Clearwaters gave me the following account of their occurrence in Putnam County, Indiana. "On July 27, 1891, Jesse Earll was down beside the old mill pond, where we collect all our water birds, and noticed five birds on the ground apparently probing in the mud with their bills. As they rose he shot one which proved to be a male Red Crossbill in breeding plumage. He preserved the skin and still has it. The others were females or young, as he says none of them had any red on them."

Mr. Jonathan Dwight reported the American Crossbill on North Mountain, Penn., in June, 1891 (The Auk, Vol. IX, p. 137). Dr. B. H. Warren in his admirable report on the Birds of Pennsylvania, p. 228, gives it as breeding in the counties of Clinton, Clearfield, Luzerne, Lycoming and Cameron, in that state.

March 1, 1892, Messrs. A. B. Ulrey and E. M. Kindle report seeing six in Monroe County, Indiana. Mr. G. G. Williamson

noted six near Muncie, Indiana, April 16, 1892, and another April 24. Messrs. Charles D. and Lewis A. Test have kindly sent me the following interesting notes from the observations of the spring of 1892. The notes were taken near Lafayette, Indiana, March 8, 1892, they saw the first American Crossbill. They were seen on the following succeeding dates: March 11; April 15, 19, 23 and 30; May 1, 3, 6, 8, 18, 20, 21, 27 and 30; June 2, 6, 22, 23, 27 and 30. The birds were seen in pine trees and also in yards and along the road. Search was made for nests but none were found. I am indebted to Mr. Otto Widmann for some valuable notes relating to the American Crossbill in Missouri last winter and spring and summer (1891 –2). He says :—" I never suspected these cone-loving nomads to descend into a country so flat and uninteresting as St. Louis County, Mo., where Nature never rears a cone without the help of the gardener. Thousands of young evergreens, especially Norway Spruces, have been planted during the past decade, but old cone-bearing conifers are few and far between. There are on my place, besides a few Norway Spruces, 18 pine trees about 30 years old. Half of them are Austrian Pines, the rest White and Scotch Pines.

Coniferous trees do not bear fruit every year, but last winter the Austrian pines were full of cones, getting ready to drop the seeds in early spring. Besides the maturing pine seeds, our section had another attraction for erratic fruit-eaters in the orchards. The apple trees had yielded an enormous crop and the demand not being sufficiently great to gather them in time, thousands of apples were still hanging in the trees when the Crossbills appeared on the scene. It was in the orchard that they made their appearance on Nov. 13, the day after the first "blizzard" had visited the upper Missouri Valley. From this day on, the Crossbills remained in the neigborhood until the end of the month, but none were here in December and January, at least I did not notice any until they began to visit my pine trees in February. They were daily visitors all through March and until the 17th of April. From that day until May 8th none were seen, but from the 8th to the 14th they were again daily callers. After this date they were

noticed twice; a party of six on June 5th, and two birds, a male and female, in one of my pine trees on July 21st. I looked for the nest in the tree, but unfortunately it was not there. I think now that I have met with the species on several occasions in former years but did not know them. Frequenters of private gardens, they were only seen when on wing or distant tree tops and evaded identification. With us it is a shy and restless bird, easily alarmed and flying a great distance. Before taking wing and while in the air they are quite noisy with a note closely resembling the parent call of *Progne;* but when feeding in a pine tree the whole troop keeps perfectly silent and nothing is heard but the noise made by breaking the cone scales. When present in May they are also feeding on elms."

Mr. W. S. Blatchley gives me the following notes:—"While sitting on the porch of a farm house in Putnam County, Indiana, July 11, 1892, I saw a single Crossbill *Loxia curvirostra minor* alight in the top of a pine tree in the yard and begin searching the cones for seeds. I watched it for almost ten minutes and then, that there might be no possibility of mistake in the identification, procured a gun and shot it. It proved to be a young male. On July 15th, another young male, i. e., a male presumably of the previous year's hatching, was secured from the same tree and kept in confinement for several days, but was finally allowed its liberty."

The American Crossbills have, as has been shown, been noted within the region between the great lakes and the Ohio River in the following winters: 1868–9; 1869–70; 1874–5; 1882–3; 1883–4; 1884–5; 1885–6; 1887–8; 1888–9; 1889–90; 1890–91; 1891–2. From 1882 to 1892 they were only absent one year, 1886–7. In the winters of 1882–3; 1884–5; 1887–8, the area of dispersal was wide and the birds seem to have been generally distributed. Other years as 1868–9; 1869–70; 1883–4 they appeared, or at least were observed, in but few localities, but where noted they were abundant.

The results of the inquiries concerning its summer range, particularly with relation to the Ohio Valley and the territory adjacent thereto have been wholly unexpected. Summing

up the occurrences in summer and the evidence of its breeding in the region last referred to we note as follows. In the summer of 1869 they were abundant in the vicinity of Chicago, both in Illinois and Indiana. In the summer of 1878 they were found at Columbus, Ohio, and abundantly at Cleveland where it was reported to have bred. Dr. Wheaton refers to their having nested in Indiana as a fact well known to him. Dr. H. A. Atkins is said to have taken nests of this species near Locke, Michigan, in 1880. The spring of 1885 they were common at Michigan City, Indiana, and Mr. Brykit thought they might have nested. In the summer of 1885 they were reported to have nested in Tippecanoe County, Indiana. The same summer they are reported to have nested at Bloomington, Indiana. They were reported from Monroe County, Indiana, three different dates in July, 1886. They were reported from Putnam County, Indiana, in the summer of 1891–92. They remained throughout a part of the summer of 1892 at Lafayette, Indiana. They remained even later at Old Orchard, Mo., in 1892.

These notes but serve to bring more clearly to mind the peculiar, erratic character of the bird of which we have known, to some degree, before. The notes would also seem to indicate that much of our lack of data is due to the scarcity of observers in years past. A few years ago the collection of data regarding almost any species of bird from Indiana, or almost any other state, would have been impossible. It is not improbable, could we begin with the abundance of Crossbills at Cincinnati in 1868–9, with a number of intelligent observers equal to that available now, we could have a collection of observations covering its whole range between the Ohio River and the lakes and perhaps including its movements for almost every year. These blank years do not necessarily signify that it was wanting in the territory studied, but that for some one of a great many reasons, it was not observed. The erratic distribution of the species applies as well to its summer range as to that in winter. It seems very probable that the species breeds to some extent throughout the Ohio Valley. It is true that no specimens representing either the nest or eggs have

been, so far as I know, preserved. Yet the evidence presented indicates that the breeding range of the species in the United States is not confined to the coniferous forests of the mountain ranges.

Loxia leucoptera, WHITE-WINGED CROSSBILL.

This species is not met with in the Ohio Valley so often as the last mentioned form. Its range lies farther to the northward. Its distribution within the United States, both in winter and summer is much less extensive than is that of the American Crossbill. Audubon mentions its breeding in Pennsylvania in summer, but this is probably an exceptional case. Dr. J. M. Wheaton gave it in his catalogue of Birds of Ohio in 1861. Mr. Charles Dury found them abundant in the vicinity of Cincinnati, Ohio, in the winter of 1868–9, in company with the last mentioned species. He says "they were in large flocks containing both species in the proportion of two of the former to one of the latter" (the present), "species." Mr. C. E. Aiken informs me that this species was in company with the American Crossbill when they were so common in the vicinity of Chicago in the summer of 1869. He also noted them in Lake County, Indiana, the latter part of August of that year. He says they displayed the same habits as the preceeding species. His recollection is that the white-winged forms was less abundant, a little later in their arrival, and more wary. They remained through the winter. Professor A. J. Cook informs me that one was killed by Dr. A. H. Atkins at Locke, Michigan, Aug. 9, 1875. A pair of white-winged Crossbills were taken at Fort Wayne, Indiana, about 1878. The female is now in the collection of Mr. C. A. Stockbridge of that city.

Mr. W. L. Scott notes the occurrence of a flock of white-winged Crossbills near Ottawa, Canada, toward the latter part of June 1882 (The Auk, Vol. I, p. 159). Mr. Fletcher M. Noe notes the occurrence of this species near Indianapolis, Indiana, in the early part of 1883. Feb. 6, 1883. Professor B. W. Evermann shot two males from a flock of fifteen of these birds in a yard at Bloomington, Indiana. Feb. 10, he secured a

female and, a few days later, two other specimens near the same place. Miss H. E. Colfax reports it from Michigan City, Indiana. June 26, 1884, Mr. J. W. Byrkit found both species together in large flocks near Michigan City, Indiana, the winter of 1883–4. Mr. Charles Dury reports it from Michigan City, Indiana, he thinks in 1885. Faxon and Allen report seeing a few in the White Mountains, N. H., June, 1886. (The Auk, Vol. V, p. 152). Hon. R. Wes McBride has noted it as a winter visitor in De Kalb County, Indiana. Dr. C. Hart Merriam gives it as a resident in the Adirondack region but adds, comparing it with the American Crossbill, "not nearly so common as the last." (Bull. Nutt. Orn. Club, Vol. VI, p. 229). Professor B. W. Evermann informs me that he saw one in the spring of 1886 in his brother's yard at Burlington, Indiana. He says "after watching it for awhile I struck it with a stick, killing it." March 16, he saw another specimen of this species at Camden, Indiana.

The only instance I know of its occurring in the Ohio Valley in summer, is that given by the late Mr. C. H. Bollman. He wrote me that he saw eleven on a fir tree in Bloomington, Indiana, June 24, 1886. A few days later he several times noted specimens of the other species.

Everywhere in the Ohio Valley this species seems to be quite rare and exceedingly irregular in its occurrence. Mr. E. W. Nelson and Mr. Otho Poling note it as much less common in Illinois than formerly. With the exception of the winter of 1868–9 and the succeeding summer, I do not know of its having appeared in any considerable numbers in any of the tier of states just north of the Ohio River.

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RECENT LITERATURE.

Zirkel's New Text Book of Petrography.[1]—Although entitled a 'Lehrbuch' the revision of Prof. Zirkel's well known Petrography has rather the character of a 'Handbuch.' The first of the three volumes proposed to complete the work contains an introduction to the study of rocks, a description of the methods made use of in this study, an account of the peculiarities of form presented by rock-forming minerals, a review of the characteristics of each of the most important of these, a discussion of rock structure and the causes of its variation, a statement of the method of occurrence of rock masses, a chapter in the physical properties of rocks and one on the changes which they undergo when subjected to external influences. Following these, which occupy in all 635 closely printed pages, there are some 190 pages in the mineral, chemical and structural relations of massive rocks, and a very full discussion of the theories proposed to explain the origin of the variations observed in rock masses, and in the different emanations from the same volcanic centre, which concludes with the scheme of classification for massive rocks that the author intends to follow in the succeeding volume.

As the synopsis of the contents shows Prof. Zirkel expects to cover the entire field of petrography in a way that has never been attempted hitherto. He will treat not only of the massive rocks, but of the sediments and crystalline schists as well. The first volume gives no evidence as to the fullness with which the individual rock types will be discussed, but it is quite certain that the three volumes will fill a place that has long been ready for them in the working room of every petrographer.

The special excellencies of the volume before us consist in the very complete bibliographies appended to or inserted within the paragraphs pertaining to different heads, the thoroughness with which the field has been covered by it, and the freshness of the material between its covers. Of course the second edition is not a revision of the author's first edition of the Lehrbuch. It is an entirely new book, rewritten from 'preface to finis.' And more than this—it contains references to the very latest petrographical researches published in this country as

[1]Lehrbuch der Petrographie by Dr. Ferdinand Zirkel. 2te Aufl., Erster Band. Leipzig, Wilhelm Engelmann, 1893. Pp. x and 845.

well as in Europe. The faults of the book are such only when it is criticized as a Lehrbuch. As a manual it is very satisfactory, though one would wish that the author had made his list of rock-forming minerals more complete than it is, and had given more detailed instructions as to the manipulations in some of the investigation methods mentioned. Upon comparison with Rosenbucsh's first volume it is found that this treats of forty-four more minerals than does Zirkel's book, but then the Heidelberg volume deals only with microscopical petrography. Further, the absence of illustrations from the Lehrbuch will prevent its use as a text book for students, and the failure to attempt an explanation of the action of mineral plates toward polarized light will in large measure keep it from even our universities and technical schools. But these faults, we repeat, are faults in a text book. They are not altogether weaknesses in a hand-book. Zirkel will become the reference book of petrographers, while Rosenbucsh will remain their text book.

In that portion of the volume occupied with the special discussion of massive rocks, the author outlines his classification and gives his reasons for it. He declines to recognize the dyke rocks as a well established class, and so makes his division (according to structure and mineralogical composition) into granular and porphyritic groups, and then into types. In the first group, age distributions are disregarded. In the second group the old distinction between pre-tertiary and tertiary volcanics is revived. Petrography is regarded as primarily as a study of rock bodies, and secondarily as a branch of geology.

The lack of illustrations which has already been noted will not detract seriously from the value of the volume as a reference book, as the author has no new structures to define and no new rock-types to establish. He gives an excellent resumé of petrographical literature and there stops. He has no theories to advance and no attacks to his brother investigators, except now and then, a mild one upon Rosenbusch, and his discussions upon the literature are uncolored by his own views. Now and then a criticism is interjected into the discussion, but upon the whole the author allows the conclusions reached in the articles cited to stand unchallenged, or if they are challenged it is by the citation of other authors. In brief the Lehrbuch is an excellent résumé of our present knowledge of rocks and a fine reference book to petrographical literature. Naturally more interest will be felt in the two volumes to appear, than in the first volume, for at least one of these will afford a starting point for a systematic petrographical study of the crystalline schists.

W. S. B.

Zimmermann's Botanical Microtechnique.[2]—In bringing out so promptly an English translation of this useful work, the German edition of which reached American workers a little more than a year ago, both translator and publisher have rendered a good service to the laboratory botany of the country. The original was so well received, and had proved itself to be so useful in the laboratory, that this neatly printed and bound volume must at once find wide and general use. The beginner will find here a work which he may follow implicitly without fearing that he will laboriously learn some method, only to find a little later that it is an antiquated or discarded one.

In order to give those who have not seen the original an idea of the scope of the work we reproduce the contents of Part I.

General Methods.

1. The Observation of Living Plants and Tissues.
2. The Investigation of Dead Plants.
3. Maceration.
4. Swelling.
5. Clearing.
   A. Chemical Clearing Methods.
   B. Physical Clearing Methods.
      I. The Ordinary Method of Transfer from Water to Canada Balsam.
      II. The Transfer from Water to Canada Balsam without Alcohol.
      III. The use of other Strongly Refractive Mounting Media.
6. Live Staining.
7. Fixing and Staining Methods.
   A. Fixing. B. Removal of Fixing Fluids. C. Staining.
   D. Fixing and Staining Microscopically small Objects.
8. Microtome Technique.
   I. Imbedding in Paraffine. II. Imbedding in Celloidin. III. The Attachments of Sections.
9. Making Permanent Preparations.

From the foregoing it will be seen that every point under the head of general laboratory methods is taken up, and an examination of the paragraphs shows the thoroughness of the work. The illustrations of which there are many, add much to the usefulness of the work.

[2]Botanica Microtechnique. A handbook of methods, for the preparation, staining and microscopical investigation of vegetable structures by Dr. A. Zimmermann, Privat-Docent in the University of Tübingen. Translated from the German by James Ellis Humphrey, S. D. New York, Henry Holt and Company, 1893, pp XII, 296.

Dr. Humphrey has added here and there many valuable notes, and at the end has added six pages of useful "Tables for Reference." The literature of the subject is given with such completeness thas it requires nineteen pages. A full index with from 1200 to 1500 references completes this most satisfactory book.

CHARLES E. BESSEY.

The Letters of Asa Gray.[3]—It is rarely the case that a life is more justly and clearly set forth in a biological writing than is the life of the eminent botanist Asa Gray, in those two volumes prepared by Mrs. Gray. With rare good taste and admirable tact she has woven from the brief autobiography and the letters scattered through fifty-six years the charming story of his life. We can all wish for a such hand to set forth our life-work, when we have passed away.

The quaintly written autobiography tells of his early life, and of his struggles to reach some position in which he might do the work Nature had fitted him to do. There were many disappointments; many plans were made only to be overthrown or abandoned. At last came the appointment to the chair of Natural History in the newly chartered University of Michigan, and the year's leave of absence and commission to purchase books for its library. How well he used that year in Europe is told in the enthusiastic letters he wrote home to Dr. and Mrs. Torrey and "the girls." Thenceforward his life-work was assurred, and upon his return he took up with vigor the work on the Flora of North America with Dr. Torrey, a work which he left unfinished after forty-eight years of continuous work.

It is impossible to give an adequate idea of these books in a brief notice. These extracts from letters more than fifty years apart may be suggestive. To his mother he wrote from New York in February, 1835, "I wish very much to spend a few weeks Georgia early in the spring, but I see that I shall not be able to do so. My time is spent here very profitably, and I am advancing in knowledge as fast as I ought to wish, but I make no money, or scarcely enough to live upon. Just at present I am rather behind hand, but think that by next fall I shall with ordinary success be in better circumstances. It is unpleasant to be embarrassed in such matters, for I should like much to be independent, and this with my moderate wishes would require no very large sum, and I have no great desire to be rich."

[3]*Letters of Asa Gray.* Edited by Jane Loring Gray, in two volumes.. Boston and New York, Houghton, Mifflin and Company. The Riverside Press, Cambridge, 1893, 12 mo., 838 pp.

Contrast the foregoing with the following written from Kew, April, 1887, to De Candolle.

"You will be a little surprised at the sudden transfer of Mrs. Gray and myself to England, but I wanted a vacation and one more bit of pleasant travel with Mrs. Gray while we are both alive and capable of enjoying it. Whether I shall look in upon you at Geneva is doubtful, but it may be even for a moment. We never expect to have repeated the pleasant work at Geneva of the spring of 1881. We expect to go to Paris in May, but subsequent movements are uncertain. Always dear De Candolle, affectionately yours."

These volumes will always be interesting to American botanists, especially to those who enjoyed Dr. Gray's personal acquaintance.

CHARLES E. BESSEY.

A Theory of Development and Heredity.[4]—This volume recently issued by the Macmillans with the above title will no doubt find a good many readers. It is a book that deserves perusal, in that it presents with clearness the main issues that are how agitating biologists, though the bias of the author is decidedly Lamarckian. In fact, it is probably the strongest popular contribution to the Lamarckian side of the controversy that has yet appeared. The author states that in the first place the work is an effort to extend the application of the law of the conservation of energy to the phenomena of living matter, and to resolve the premises given by the science of physics to their conclusion in the realm of biology. How far he has succeeded may be open to question, but his array of facts in support of his views is certainly very creditable. Many of these facts have been known for a good while to biologists, but the author of the volume has brought them into their proper collocation in respect to each other and has made out a very strong argument in support of his position. In the second place, to use his own words, "it is the extension to all living matter of certain fundamental properties of life which psychology has either proved or tacitly assumed to exist in the higher animals." He here refers to the effects of repetition and association operating through a coördinating nervous mechanism or system. His view of organic evolution, is that it is a mechanico-psychological process. In this respect his views are closely similar to those of Cope published long since in a collected form—Cope's view is that consciousness is to be regarded as an important factor in evolution, just how it operates is

[4]A Theory of Development and Heredity, by Henry B. Orr, Ph. D. Macmillan & Co., London & New York, 1893, crown 80, pp. ix and 255.

not so definitely stated as by Orr, who finds in the nervous system the coördinating mechanism through which consciousness manifests itself, but under the domination of the laws of the conservation of energy.

The author does not claim to have made any new discovery, but only to have brought known facts into new relations. There is however, a lamentable defect palpable throughout the book in respect to the citation of authorities. In some cases, in which our author is not alone, he entirely forgets to cite those who have published similar views long before the appearance of his work. The suggestion that all biological phenomena must be interpreted in terms of the theory of the conservation of energy was a thesis defended in several papers published by the present reviewer during the last five years. In his argument in support of the first view that energy must be considered first of all, the author also fails to appreciate the great complexity of the mechanism represented by the cell, nor does he seem to have made himself familiar with the very important and pregnant results of Quincke, Bütschli, Berthold, Dreyer and others. In another place a discovery is mentioned that is undoubtedly to be the first of all accredited to Prof. Alpheus Hyatt, instead of to Wurtenberg, namely, that evolutionary changes in the Ammonites first show themselves on the outer or last whorl of the shells of these organisms. No credit is allowed Prof. Eimer on p. 63, where in a few sentences some of the most important results of that ingenious writer are epitomized in regard to growth itself as a factor in organic evolution. In the chapter on the origin of variations, there is some very crude speculation, that will hardly bear critical examination, and in one place the author shows that he is altogether unfamiliar with Fick's very important and interesting experiments bearing on the origin of joints and the forms of articular surfaces. *Actinosphærium* is misspelled "*Actinosphæra*," and a *cellular* structure is ascribed to this protozoan, and the author also falls into a teleological trap when he asserts that the vesicles and their walls "cellular spaces" in this organism are for the purpose of giving it permanence of figure and support. On page 49, it is stated that "pigment is caused by light acting upon the tissues and where there is no light there can be no pigment." To this it might be replied, how about the black pigment of the *substantia nigra* of the human brain; that is certainly shut out from the light in the centre of the head? With certain reservations it is however, certainly true that pigmentation is associated with the influence of light as the experiments of Cunningham and Schiedt on widely diverse forms have proved. The direct and interesting correlation between coloration and

latitude, first noticed by the late Prof. Baird to hold of closely allied species or of individuals of the same species from different latitudes is not mentioned by the author. The principle of acceleration and retardation, first strongly put forward as early as 1869 by Prof. Cope is also not mentioned, though partly involved in Weismann's quoted statement of the laws governing the ontogenetic appearance of characters given on p. 141.

This failure to render credit where a citation by title would have answered the purpose, is all the more evident by reason of the way in which American naturalists generally have been ignored, as is shown by the details given above, but to which much might be added. The introductory chapters are very suggestive, however, and bring in certain physical evidence in a new way. Especially suggestive is the theory of after-effects here foreshadowed, and which is especially well supported by facts cited from Detmer in Chapter IV. The fallacious arguments of the ultra-selectionists in regard to the origin of blind cave forms, are ingeniously answered in Chapter XII. The results of Stahl and Frank in changing the structure of plants by charging their environmental relations are epitomized, as well as Born's and Yung's experiments in determining the sex and growth of tadpoles by means of the food are briefly detailed and used as evidence. No reference is made to the experiments of Mrs. Treat or of Mr. Gentry in this connection.

To sum up the book is well worth careful perusal, and is to be commended to students of the present activity amongst naturalists in regard to the problems of heredity. Dr. Orr's book, on the whole, presents the Lamarckian side of the argument with unusual fairness and completeness. The book would be greatly improved by the addition of a full index which it is to be hoped may be supplied in a future edition. This book is also an indication of the tendencies of the times, namely, of an effort to trace all phenomena including those of life to their physical sources. That such end will some day be achieved there can scarcely be any doubt, since experimental endeavor is now busy with the work of imitating the phenomena of life by artificial and experimental means, such for example, as the production of artificial amœbæ.—R.

The Wilder Quarter-Century Book.[5]—This volume is a col-

[5]The Wilder Quarter-Century Book. A Collection of Original Papers dedicated to Prof. Burt G. Wilder at the close of his twenty-fifth year of service in Cornell University (1868–1893). By some of his former students, Ithaca, N. Y., 1893.

lection of scientific memoirs published by some of Prof. Burt Wilder's former students, to commemorate the twenty-fifth anniversary of his connection with Cornell University. These essays deal with a wide range of subjects, but are mainly in the line of evolutionary thought. Among the contributors are artists, instructors, physicians, officers in government departments, professors in medical colleges and in universities, and a university president. The papers are prefaced by a list of the more important scientific publications of Prof. Wilder, and a brief sketch of his work at Cornell University, including a table of the number of students personally taught by him during each college year from the beginning of the University (1868) to the twenty-fifth commencement, (1893).

The illustrations comprise an excellent portrait (Japan proof), 26 plates, and 36 figures in the text.

The book embraces many papers which contain the results of original scientific research by their authors. The whole constitutes a permanent monument not only to man whom it was assigned thus to honor, but to Cornell University, and to the devotion of the contributors to the true spirit of science.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Geological Structure of the Mount Washington Mass of the Taconic Range.—The recent studies of Mr. Wm. H. Hobbs have disclosed new facts with regard to the Mount Washington Mass and the conclusions that the author draws from the data now known differ somewhat from those reached by Mr. Dana regarding the structure of Mt. Washington.

Mr. Hobbs' paper is prefaced by the following brief account of the topography of the region in question:

"That portion of the Taconic Range which is known as Mount Washington is both topographically and geologically a unit. It covers an elongated elliptical area, about fifteen miles in length and four and one-half miles average breadth, lying in the states of Massachusetts. Connecticut and New York. It occupies the entire township of Mt. Washington and portions of Sheffield and Egremont in Massachusetts; about one-third of Salisbury in Connecticut; and portions of Northeast Ancram, Copake and Hillsdale in New York.

The Mt. Washington mass is a double ridge enclosing a summit plain. Mt. Everett, or the "Dome of the Taconics" (2624 ft.), lying in the eastern ridge, is the highest peak and one of the highest elevations in Massachusetts, while the Bear Mountain (2355 ft.) is the highest point of land in the state of Connecticut. The main summit plain is situated to the northward centre of the mass and has an average altitude of about 1700 feet. Corresponding with the elliptical outline of the mountain, this plain is compressed at the north and south, so that its length is about three miles and its breadth two miles. Encircling it is a line of peaks ranging from 1900 to 2600 feet in height. This encircling wall of peaks is buttressed by other peaks both to the northward and to the southward, the southern side being strengthened, by a parallel belt across the mountain, composed of Mts. Bear, Gridley, Frissell and Monument. Southward of this belt of hills the elevated plateau recurs, but without the rampart of peaks which characterize it in the northern and more central area.

"The Salisbury-Sheffield valley on the east and the Copake-Hillsdale valley on the west of the mass, constitute a floor having an average altitude of 700 feet, from which Mt. Washington rises abruptly,

the mean slope-angle being 20°. The southern boundary of the mountain is the nearly east and west valley through which runs the Central New England and Western Railroad. On the northwest Mt. Washington is merged into the narrow ridge of the Taconics, which extends northward into Vermont. The name, Mt. Washington, however, applies properly to all of the range lying south of the South Egremont-Hillsdale turnpike. The regular elliptical contour of the mass is broken on the northeast by two deep embayments, the eastern one containing Fenton Brook, and the western, which is knee-shaped, being occupied by Sky Farm Brook. The regularity of contour is further interrupted by an outjutting spur on the west side, known as Cook's Hill. South of the topographical break which limits the mountain in the neighborhood of Ore Hill, the range of the Taconics pursues a more interrupted course, the hills becoming smaller and spreading out considerably."

In the account of his investigations the author states that a microscopic examination of thin sections of rocks from Mt. Washington shows clearly that they are strongly metamorphosed clastics. Evidence has been deduced from the secondary growths of feldspars, garnets and tourmalines, as well as from the relations of the different metamorphic minerals to one another, to show that the orographic forces to which these minerals owe their development, operated in several more or less distinct periods.

What is set forth in the paper agrees with Professor Dana's views so far as the northern portion of the area is concerned. It is in regard to the southern and central portions that different views are entertained. Mr. Hobbs attributes this difference, not to errors in Professor Dana's observations, for in the main they have been confirmed, but to the collection of a larger number of observations and to the application of some structural principles which were not made use of by Professor Dana.

In conclusion Mr. Hobbs gives the following summary of the results discussed in the paper:

"The Mt. Washington series consists of four members which, in order of age are as follows: (1) Canaan Dolomite, (2) Riga Schist, (3) Egremont Limestone, and (4) Everett Schist. A somewhat striking lithological distinction is found to separate the two schist horizons, the Everett shist being entirely free from garnet and staurolite, while the Riga shist usually (not always) contains macroscopic crystals of one or both. The older rocks are found in the southern portion of the area, a general northerly pitch carrying them successively below the

surface as we proceed northward, until at the north end of the mountain we find the upper two members of the series only.

"The structure of the mass may be summarized by stating that the beds have been thrown into corrugated folds which seem to have moderate, tolerably symmetrical corrugations at the south end of the mountain, but these corrugations deepen and become frequently overturned as we proceed northward. In the eastern portion of the area the axes of the reversed folds is generally westward. At the extreme south, the structure is a geo-anticlinal, but this develops in the central and northern parts of the area into a geo-synclinal owing to the continual disproportionate deepening and widening of one of its minor western corrugations. The general pitch of the beds is north. A less important southerly pitch which characterizes the northern portion of the area, in combination with the general synclinical structure in cross sections, gives to all the mountain except its extreme southern portion a basin-like character. The rocks are throughout strongly metamorphosed clastics, the orographic disturbances to which they owe their marked crystalline character and porphyritic crystals having operated in several distinct periods. The Egremont Limestone shows a marked diminution in thickness as we proceed southward in the area until it almost disappears. Throughout the mountain plain it is greatly modified, being either a micaceous limestone or calcareous mica schist, or a graphitic schist. The graphitic rock is most developed near the schist contacts and in the southern portion is the only representative of the limestone (Journ. Geol., Vol. I, 1893).

Origin of the Pennsylvania Anthracite.—In a recent Bulletin of the Geological Society of America (Nov. 1893) Mr. J. J. Stevenson discusses the origin of the anthracite coal of Peensylvania. After stating the hypotheses that been advanced by Rogers, Owens, Murchison and Lesley, to account for the variation in the volatile combustibles in Pennsylvania coals, and pointing out objections to each in turn, the author offers one of his own, giving the facts upon which it is based. He conceives the coal-measures marsh to have had its origin to the east, and that it extended seaward after each period of accelerated subsidence, so forming a new coal bed. One should find, according to this hypothesis, a greater mass of coal in the northeastern portion of the Appalachian basin than in any other part, and also a greater degree of conversion. Observation has shown that this is the case. There is also a direct relation between the increasing thickness of coal and the decreasing volatile in Pennsylvania. This fact is demonstrated by Mr.

Stevenson in a table of ratios, the result of analyses made by Mr. A. S. McCreath.

In origin then, according to Mr. Stevenson, the anthracite of Pennsylvania differs in nowise from the bituminous coal of the Appalachian basin, but is the result of a longer exposure to the process of making.

Cretaceous System in Canada.—In a Presidental Address before the Roy. Can. Soc., Mr. Whiteaves gave a resumé of the present knowledge of the Cretaceous system in Canada. For convenience, he divides the system into Upper and Lower with the base of the Dakota group as a boundary line. In Manitoba and the Northwest Territories all the Cretaceous rocks as yet examined are referable to the upper division and are subdivided into 5 formations, viz.: Laramie, Montana, Belly River, Niobrara—Benton and Dakota. Of the Rocky Mountain region, inclusive of the Foot-Hills, the author states "that from the combined evidence afforded by the fossil flora and fauna of the Cretaceous rocks of this region it would appear that the Laramie, the Montana, the Niobrara-Benton and perhaps also the Dakota are there represented. The Kootanie series, and the Devil's Lake deposits are older than the Dakota formation and hence referable to the Lower North American Cretaceous." In British Columbia and the Yukon district, although the Cretaceous rocks have been studied and reported upon since 1871, the subdivisions have not yet been satisfactorily correlated with those of Manitoba.

In conclusion the author gives a tabular statement, showing the important additions that have been made to our knowledge of the Canadian Cretacic system since the confederation of the provinces in 1867. Prior to that time but little had been done; to-day, 108 species of fossil plants and 358 fossil animals have been recorded and described, exclusive of the Laramie, or 179 species of plants and 394 animals, inclusive of the Laramie (Trans. Roy. Soc. Can., Sect. IV, 1893).

Evidences of a Submergence of Western Europe at the close of the Glacial Period.—For a number of years Professor Joseph Prestwich has been investigating a peculiar superficial drift found in the south of England and extending over large continental areas. For this drift he proposes the name, Rubble-drift, to distinguish it from the valley, marine and glacial drift of the same regions. It includes a peculiar débris in Loess, the Breccia on slopes, the "Head" over the Raised Beaches, the Basement gravels of many valleys and the Ossiferous fissures. This drift is characterized by (1)

being composed of material of local origin, (2) a complete absence of that wear which results from maintained river, sea or ice action, (3) organic remains which are those of a land fauna alone, (4) by bone fragments free from all marks of gnawing. In order to account for these conditions as well as for the mode of distribution of the rubble, which appears to be from many independent centres, Mr. Prestwich offers the following theory. The Rubble drift is the result of the submergence and re-elevation of a land surface from beneath deep waters after a temporary submergence.

According to the author, this submergence occurred at the close of the Glacial, or so-called Post-glacial period, and immediately preceding the Neolithic or recent period. The submergence affected western Europe and the Mediteranean coasts decreasing eastward. The Rubble-drift and osseous breccia are but slightly developed in Syria. In regard to the north coast of Africa, Mr. Prestwich doubts if the submergence extended beyond the Lybian desert, as there is no well defined proof of it in Egypt.

The significance of the Rubble-drift has an important bearing upon an estimate of the lapse of time since the close of the Glacial period. Mr. Prestwich calls attention to this in his closing remarks, citing evidence to show that Mr. Croll's reckoning of 80,000 years is not supported by the facts of geology. The position and character of the Rubble-drift shows that the transition from the so-called Post-glacial beds to the recent alluvial deposits is abrupt, and there is no absence of sedimentation or anything indicative of lapse of time between the two series. This conclusion is confirmed by sections of the Belgian caves.

Neither is the Croll theory, in the opinion of the writer, warranted by archeological evidence, for "it is hardly probable," to quote the author, "that Man, who showed himself progressive early in the Quaternary period, could towards its close, have remained for, say 70,000 years, without further progress than that shown by Man of the early Stone period. There is nothing to represent, geologically, that long period of time, nor have biologists been able to detect any essential structural differences between Palæolithic Man and Neolithic Man in support of such a conclusion. All the evidence tends to prove that late Glacial (or post-glacial) Man, together with the great extinct Mammalia, came down approximately to within some 10,000 or 12,000 years of our own times, and that the Rubble-drift marks the stroke of the pendulum when the Glacial period came to a close, and the Neolithic age commenced."

A number of cuts and a map of western Europe showing the chief places submerged illustrate the text (Phil. Trans. Roy. Soc. London, Vol. 184, 1893).

Geological News, General.—According to Mr. Oldham, the three main divisions of India are natural regions. The peninsula consists of land which has not been submerged since the early Paleozoic period. The continental has been frequently under water until the Cenozoic, while the great plain is recent alluvium. There is paleontological evidence of a continuous land connection between India and Africa in the Cretaceous period. At the close of the Cretaceous there was an outbreak of volcanic activity contemporary with a series of earth-movements which led to the first appearance of the extra-peninsular mountains, and the depression at the base of the Himalaya. This activity continued during Cenozoic time. (Nature, Dec., 1893.)

Mr. Robert Hay gives some interesting results of a boring made at Paola, in eastern Kansas, which reaches a depth of 2,500 feet. After passing through the coal measures and subcarboniferous it is difficult to determine the formations, the samples being so finely comminuted. At 2,100 feet granite is reached, at first a gray granite—angular quartz and mica with some feldspar—and then a red feldspar with little mica and no quartz, like the outcrop at Ute Pass, Colorado. (Trans. Kansas Acad. Sci., Vol. xiii).

Archean.—In a study of a group of quartzite exposures in southeastern Wisconsin, Mr. Buell finds evidence of dynamic action accompanying the metamorphism of these rocks which is at variance with the more common structure of the pre-Cambrian quartzites of the region of the Great Lakes and Upper Mississippi, as described by Dr. Van Hise. These differences afford criteria for the separation of the quartzite drift of this area from boulder material from other sources and enables a more exact delineation to be made of the boulder trains that extend upon and within the different glacial formations of the Rock river valley. (Trans. Wisc. Acad., Vol. IX, 1893.)

Mesozoic.—Two new Ammonites from the Cretaceous rocks of Queen Charlotte Island are described by Mr. J. F. Whiteaves. Both specimens are small but clearly referable to the family of Stephanoceratidæ of Neumayer. The first, *Holcostephanus deansii*, belongs to the small group of which *H. astieri* is the type ;the second, *Hoplipes haidaquensis*, is very similar to *H. sinuosus* of the French Neocomian. (Can Record Sci., Oct., 1893.)

According to Mr. S. W. Williston the thickness of the Niobrara rocks in Kansas have been underestimated. Repeated observations at Elkader, in Logan Co., give 290 feet between the bottom of the valley and the highest Niobrara rocks. Wells in the vicinity penetrate 40 feet without passing through the blue chalk. To this, for stratigraphical reasons, he adds 100 feet, giving as a minimum 430 feet at a total thickness at this place. (Trans. Kansas Acad. Sci., Vol. XIII.)

Cenozoic.—Mr. C. T. Simpson reports eight species and one variety of Unios and six species of other fresh water shells from the drift of Toronto, Canada. All the Unios are characteristic forms of the Mississippi Valley, and only three have ever been reported before from Canada. The fossils were obtained from a bed of sand between two glacial beds in a railway cut, 20 or 25 feet above the River Don. Mr. Dall calls attention to the important bearing which these fossils may have upon the theory of a mild interglacial period, during which these Mississippi species attained that region where they flourished for a time and were then destroyed by an advance of the ice. (Proceeds. U. S. Natl. Mus., Vol. XVI, 1893.)

Reasoning from the data gathered for a study of the age of the extra-moraine in eastern Pennsylvania, Mr. E. H. Williams concludes that the total time of the Ice-Age, from beginning to end was small. and of so recent a date that the streams have not reached, in all cases, their pre-glacial bottoms, and the exposed rocks have not had time to acquire signs of decomposition or even oxidation. He inclines to the belief of but one ice age, and that a short and recent one. (Am. Journ. Sci. Jan., 1894.)

Mr. Alfred Bell notes the unique fauna of a post-Tertiary deposit on the shores of the Selsey peninsula in Sussex. Over 330 species in nearly all classes of organic life have been collected, the series exhibiting a purely southern facies free from any northern or boreal forms. An analysis of the list gives the following result: Non-marine, 8 Mammalia, 10 Mollusca, some fragments of insects and 3 plants. Marine, 2 Pisces, 6 Crustacea, 17 Entomostraca, 4 Cirripedia, 4 Annelida, 3 Echinodermata, 216 Mollusca, 10 Polyzoa, 50 Foraminifera, 4 Actinozoa, Algæ, etc. (Annual Report Yorkshire Phil. Soc. for 1892.)

The Manus of Hyopotamus.–Among the treasures obtained in the White River bad lands of South Dakota by the Princeton expedition of 1893 was a fine skeleton of *Hyopotamus*, which was found by Mr. J. B. Hatcher. This specimen presents a number of very unex-

pected characters, which will be described in a full account of the species, with plates, which is now in preparation. Of these, the most striking is the structure of the fore-foot, *which proves to have five well developed digits*, although the genus is a typical artiodactyl. *Hyopotamus* is thus the third artiodactyl genus in which the manus has been shown to possess five digits, the others being *Oreodon* from the White River and *Protoreodon* from the Uinta Eocene. Kowalowsky's material belonged to many different individuals, and when put together, did not suggest the presence of the pollex. In the specimen before us the first metacarpal is proportionately much longer and heavier than in *Oreodon*; its length is 41 mm. while that of the third metacarpal is 94 mm. It is quite stout, especially anteroposteriorly, and laterally compressed, with well formed distal trochlea, which demonstrates the presence of phalanges. The trapezium is large, but strange to say, has but slight connection with the scaphoid. The proximal surface of the magnum is occupied principally by the scaphoid, though to a less degree than in the oreodonts. The other metacarpals (II–V) are heavier than those which Kowalwsky has figured.

This specimen renders it altogether probable that the earliest artiodactyls were all five-toed and that the larger number of the Eocene members of the group will prove also to have been pentadactyl, though even as early as the Bridger some genera had been reduced to a didactyl condition.—W. B. Scott, Geological Museum, Princeton, N. J., Jan. 16, 1894.

MINERALOGY AND PETROGRAPHY.[1]

Globular Granite in Finland.—An occurrence of spherical granite is reported by Frosterus[2] from the southern and eastern portions of Borga in South Finland. In the midst of a number of knolls of red or gray microcline granite, is one in which spherical nodules are plentiful. Of the rock forming this knoll there are two varieties distinguished by the difference in size of their nodules. In one the nodules are small and consist of a light covered zone surrounded by a dark periphery composed of two or three concentric biotite shells. The kernel is a granular aggregate of oligoclase, some microcline, a little quartz, and considerable biotite toward the center. The rock enclosing the nodules is a dark gray granite in which quartz and microcline are more abundant than in the nodules. In the second variety of rock the nodules are large. Their kernels are like the small nodules described. Around these is usually a narrow band of feldspar and around this a zone of mica. The rock in which the spherules lie is a grayish red granitite.

After investigating carefully the relations of the minerals in the nodules to each other and the relations existing between the nodules themselves, the author concludes that the spherules existed as plastic bodies in the rock magma while this was still liquid. When in contact with each other the nodules are often distorted, whereas at other times they are broken across. It is believed that the mica and other more basic components first separated in the form of a shell enclosing some of the rock's magma, that afterward gave rise to the granular nucleus upon cooling. The nodules are thus looked upon as basic concretions, and since they are distributed through a few restricted areas only, they are thought to form basic "Schlieren." The author's article is well illustrated by several handsome plates.

The Inclusions in the Basalts of the Oberlausitz.—A further study of the granite inclusions in the basalts of Oberlausitz by Beck[3] adds a few items of information concerning the contact action between volcanic rocks and their included fragments. On the Hirschberg the granite inclusions in nepheline-basalt have had pro-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Minn. u. Petrog. Mitth., XIII, p. 177.

[3] Minn. u. Petrog. Mitth., XIII, p. 231.

duced in them spinels and augite. The dyke melilite-nepheline-basalt near Kemnitz becomes porphyritic around the inclusions. Spinels and augite are again the principal new products formed in the granite, but in addition to these glass nodules containing chalcedony and tridymite are also found in the inclusions. On the basalt side of the contact nepheline is lacking and feldspar takes its place, while the olivine of the original rock is broken and corroded. Around a few of the inclusions a mineral of the hauyne group has developed. The nepheline-basalt of the Spitzberg near Paulsdorf, contains a very large number of included fragments, around which the course of the contact processes may be easily studied. Around some of them is an isotropic glass containing microlites and trichites, while one large inclusion made up of many fragments is discovered under the microscope to have its pieces cemented by glass in which are feldspar and quartz fragments, and now and then small crystals of augite forming 'crowns' around the quartzes, besides biotite, granular colorless olivine and crystals of cordierite, which are always associated with magnetite. As the distance from the inclusion increases, the quartz and feldspar gradually disappear, augite increases in quantity and olivine of the basalt type becomes prominent. The rock then differs from the normal nepheline-basalt mainly in containing feldspar and in the absence of nepheline. Of course, at a greater distance from the inclusion, the rock assumes its normal composition.

Thermometamorphism around the Shap Granite.—In a paper published some two years ago and abstracted in the Bulletin of the Geological Society of America[4], Messrs. Harkes and Marr[5] discussed the interesting effects produced upon andesite and rhyolitic lavas and tufas and upon limestones and slates by the intrusion through them of a great mass of granite at Shap Fell, in the Lake District, England. The same gentlemen return[6] to their study in a late paper, supplementing and correcting their former statements. They find in addition to the andesites and rhyolites, sheets of basalt or of a very basic andesite, containing monoclinic and orthorhombic pyroxenes, and like the other lavas characterized by an abundance of vesicles filled with products of weathering. These have suffered contact alteration to a greater extent than have the primary constituents, though all have

[4] Bull. Geol. Soc. Amer., Vol. III, 1892, p. 16, cf. AMERICAN NATURAILST, 1892 p. 847.

[5] Quart. Jour. Geol. Soc., XLVII, 1891, p. 266.

[6] Quart. Jour. Geol. Soc,, 1893, XLIX, p. 359.

been affected near the contact with the granite. Green hornblende, brown mica, colorless pyroxene, epidote and sphene are the most conspicuous new minerals formed. These lie in a clear, granular mosaic, which may consist of newly developed quartz and feldspar. The components of the vesicles have in most cases given rise to a mixture of hornblende and quartz, but in other cases a little calcite may remain unaltered in the center of larger vesicles, while surrounding it are usually hornblende, colorless pyroxene, quartz and epidote, and sometimes in addition, zonal garnets, sphene and a few other minerals. The feldspar found within the vesicles of metamorphiosed andesites is thought by the authors to be the result of the weathering of these rocks rather than a product of contact action. In concluding their paper some interesting thoughts are suggested as to the source of the materials producing contact minerals. It is known that limestones when pure may recrystallize as marbles without the production of contact minerals, but that when impure the silica in the impurities may (and generally does) release the carbonic acid and recrystallize with the calcium as silicates. In some of the vesicles of the rocks around the Shap granite, however, the calcite has recrystallized, with the formation of silicates only around the edges of its mass, proving plainly that silica was obtained for the production of the silicates only by the calcite immediately in contact with the silicates. The conclusion is that in cases of thermometamorphism no transference of material takes place within the mass of the altered rocks except between closely adjacent points. In the production of the lime silicates studied, the interchange of lime and silica is estimated to be limited to a distance of $\frac{1}{20}$ of an inch. Other observations indicate the correctness of this conclusion.[7]

Petrographical News.—In the Obersweiler gneiss of north Vogesen are dykes of basic rocks that Andreae and Tenne[8] identify as hornblende kersantites. They consist of a panidiomorphic aggregate of plagioclase, green hornblende, a little mica, quartz, apatite, etc. Other dykes of the region are quartz-melaphryes of the navite type. The quartz is undoubtedly original. Its grains are much corroded and the resorption rims around it are composed of augite and glass. The rock is interesting as the first recorded example of a dyke rock corresponding to the volcanic quartz-basalts.

The porphyritic granite of northern Lausitz contains large numbers of apatite crystals, sometimes as many as a hundred in a single

[7]See also Journ. of. Geol., Vol. I, p. 574.

[8] Zeits. d. deutsch. geol. Ges. 1892, p. 824

thin section. As large as is this number it is exceeded in sections of the basic concretions of the rock from Niedersteina. These concretions according to Hermann[9] are made up largely of hornblende and cordierite, and thousands of apatites, sometimes reaching 1200 in a single section. The interesting features of these apatites is not, however, their number, but their forms. In many cases they are skeleton crystals whose many branches are parallel like the teeth of a comb.

The Hour-Glass Form of Augite.—This well known form of augite, according to Blumrich,[10] is usually connected with zonal growth in the mineral, and is limited in its occurrence to the pyroxene of alkaline rich magmas. It is found not only in augite, but also in other minerals forming colored isomorphorus mixtures. The hour-glass form owes its existence to the fact that different crystallographic faces in a growing mineral attract molecules of different chemical compositions, which by addition to the attracting faces build out these faces with differently colored substance. The structure is certainly not due to the filling in of the outlines of skeleton crystals, as has often been assumed. Zonal bands extend uninterruptedly through both dark and light areas in the crystals, hence the materials of both must be of the same age. The one cannot have been a later deposition than the other. Pelikan[11] in confirmation of Blumrich's view, calls attention to the fact that if strontium nitrate crystals be allowed to grow in certain colored solutions, they become colored in areas distributed in accordance with the faces by which the crystals are bounded. The central cores of chiastolite crystals, Becke ascribes in a similar manner to the attractive influence of the end faces of the crystals upon the material added during growth.

The Effect of Impurities in Crystallizing Solutions.—It has long been known that the habit of crystallization assumed by a substance depends in large measure on the medium from which it crytallizes. Araganite, for instance, will separate from certain solutions, while from others calcite is precipitated. Vater[12] has conducted a series of experiments with calcium carbonate, allowing this substance to crystallize from various solutions under different conditions; and has reached some interesting conclusions. The ground rhombohedron

[9] Neues Jahrb. F. Min., etc., 1893, II, p. 52.
[10] Minn. u. Petrog. Mitth., XIII, p. 239.
[11] Ib. XIII, p. 258.
[12] Zeits. f. Kryst. XXI, p. 433 and XXII, p. 209.

of calcite separates from all solutions of pure carbonate in dilute carbonic acid at low temperatures. In general, under different conditions of formation, differently habited crystals are produced. Moreover, different proportions of impurity in the solution affect differently the resulting crystals, as well as the rapidity with which they grow. Contrary to the prevalent belief, however, the presence of calcium bicarbonate in a solution of the mono-carbonate exerts but little influence upon the complexity of the calcite crystals formed. The article is long, and is a thorough discussion for the subject treated.

North Carolina Quartz Crystals.—Gill[13] supplements Von Rath's study of North Carolina quartz crystals by describing some new forms and giving the results of etching spheres made from simple left-handed crystals with hydrofluric acid and hot sodium carbonate. The conclusions of his crystallographic study are to the effect that the mean of the measurements of 38 crystals give an axial ratio $a:c = 1:1.1018$. This ratio, which is larger than usual for quartz, is ascribed to the lengthening of the *c* axis brought about by impurities included within the crystals. All the crystals investigated were smoky quartzes, whose axial ratio approaches that of the Swiss crystals, and is larger than that of the Riesengrunde occurrences (1 : 1.0996). The crystallazition is trapezohedral-tetartohedral, which may be best regarded as *a combination of trapezohodral hemihedrism* and hemimorphism with respect to the lateral axes. The author notes the effect of various influences upon the development of the planes observed on quartz, and closes his paper with a discussion of crystal structure. The properties of quartz are explained upon the assumption of a molecule of SiO_2 in which Si is in the center of a regular tetrahedron, from whose upper and lower edges the oxygen exercises its influence.

Two New Books.—Hatch's mineralogy[14] is an elementary text book for the use of beginners in the study of minerals. The book begins with a very elementary treatment of the systems of mineralogy based in the notion of symmetry. It defines the terms made use of in describing the physical properties of minerals and ends with seventy-five pages on systematic mineralogy. The classification used is an arbitrary one—the rock-forming minerals being first discussed, then the ores, next the salts and other useful compounds and finally the

[13] Zeits. f. Kryst., XXII, p. 97.
[14] Mineralogy by F. H. Hatch, London, Whittaker & Co., 1892. Pps. viii and 224. Ills.

gems. The descriptions are clear but very brief and the illustrations in the text are well selected. The little volume is one of the best of its kind, though this is but scant praise.

Gregory's translation[15] of Loewinson-Lessing's Tables for the Determination of Rock-Forming Minerals, adds another to the number of books thut are supposed to aid the student in the rapid determination of the most common constituents of rocks. The tables are intended to lead their user to the *name* of the mineral whose characteristics he has observed under his microscope. It is a "guide to the identification of minerals, rather than a summary of their properties." The plan made use of in the construction of the tables reminds one of the schemes familiar to the determinative botanist. Habit, color, lustre, character of double refraction, etc., serve to place the minerals in different groups, from which one whose name is sought is selected by its special characteristics. The tables appear to fill a want, but only constant use in the laboratory will prove whether or not they will assist the student to the extent hoped by the author.

Mineralogical News.—*Azurite* with the habit of Chessy crystals and large *cerussites* prismatic in the direction of the brachydiagonal are mentioned by Molengraff[16] from Willow's silver mine near Pretoria in the Transvaal. On the former the three new planes $\frac{1}{10}$ $P\grave{}_{x}$,—2 $P\grave{}_{3}$ and $\frac{1}{5}$ $P\grave{}_{3}$ occur.

On three highly modified crystals of *phosgenite* from Monte Poni, Sardinia Goldschmidt[17] has discovered the new forms $P\frac{3}{2}$ and 3 $P\frac{3}{2}$ The distribution of the more common faces seems to point to a trapezohedral symmetry for the crystals, but no circularly polarizing effects could be detected in them. The axial ratio determined from the mean of the best measurements is $a : c = 1 : 1.0888$.

An analysis of *jarosite* from the cavities of the auriferous quartzite of the Buxton Mine, Lawrence Co., S. D., has been made by Headdon.[18] His results are:

SO_3	As_2O_5	Fe_2O_3	CaO	Na_2O	K_2O	H_2O	Total
30.29	2.51	49.28	.42	4.62	1.57	11.24	= 99.93

[15] F. Loewinson-Lessing's: Tables for the Determination of Rock-Forming Minerals. Translated by J. W. Gregory, With a chapter in the petrological microscope. London & N. Y., MacMillan & Co., 1893. Pp. 55.

[16] Zeits. f. Kryst., XXII, p. 156.

[17] Ib., XXI, p. 321.

[18] Amer. Jour. Sci., XLVI, 1893, p. 24.

Three fragments of *powellite* have been obtained by Koenig and Hubbard[19] from the south Hecla copper mine in Houghton Co., Mich. The mineral has a density of 4.349. Its composition was found to be:

MoO_3	WO_3	CaO	MgO	Fe_2O_3	SiO_2	Cu	Total
67.84	1.65	27.30	.16	.96	1.52	tr	= 99.43

Native *lead* is reported by Kempton[20] as occurring in thin scales and pellets, some of which approach rectangular forms, in a gangue of pyroxene of a pale green color. It is associated with iron oxides and calcite. The location given is near Saric, Sonora, Mexico.

Methods and Instruments.—Federow[21] in a recent article elaborates a new universal method for the measurement of crystals, suggests a new system for crystallographic nomenclature and illustrates a new method of projecting crystal planes, and determining by graphical means their symbols. The universal goniometer used in his investigations is described at length and pictured in detail. The author illustrates also the application of his method to studies in optical crystallography. He describes two models of universal microscope stages, constructed for the purpose of enabling the observer to revolve the object under investigation in two directions. The plagioclases are studied and it is shown that the labor of determining their nature is much reduced by the method of work suggested by the author. The paper is an important one and and one well worthy of close study.

Czapski[22] suggests the use of the iris diaphragm between a condenser of moderate strength and the stage of the microscope for the rapid interchange of parallel and converged light, and also the use of the same appliance in the ocular tube of the instrument for the isolation of the axial figures of very small crystals.

G. Friedel[23] gives a new method for determining the value of the double refraction in thin sections of minerals that seems to be simple in its application.

Goldschmidt[24] and Jolles[25] discuss two proposed methods for projection of crystal forms. Jolles article is illustrated by five plates and sixty figures.

[19]Ib., XLVI, 1893, p. 356.
[20]Science, June 23, 1893, p. 345.
[21]Zeits. f. Kryst., XXI, p. 574 and XXII, p. 229.
[22]Ib., XXII, p. 158.
[23]Bull. Soc. Min. Franc., XVI, p. 19.
[24]Ib., XXII, p. 20.
[25]Ib., XXII, p. 1.

BOTANY.

The Number of Plants.*—It is a question of science, and, if one will, also of reasonable curiosity, to ascertain approximately at least, how many are the plants which live upon the surface of our globe. And, in fact, almost every work of general botany devotes some attention to this subject. It is indeed true that the criterion of "species" is not equal for all botanists, some having a tendency to reduce, others to multiply (on the ground of very minute differences) the number in existence. The middle criterion of Linnæus, however, prevails by great length, which, somewhat improved, predominates in the classical works of De Candolle, Bentham, Hooker, Grenier, Godron, Koch, Asa Gray, Parlatore, Caruel, etc., etc. Admitted, however, some discrepancy in this criterion, the effect would be almost insignificant in comparison with the immense number of plants. Without enlarging too much upon the successive increases which the researches of the diligent have brought to the number of plants, I will sum up these results in a chronological table:

500–400 B. C.	Hippocrates reckons	234	plants.
310–225 B. C.	Theophrastus "	500	"
77 A. D.	Dioscorides "	600	"
23–79.	Pliny "	800	"
1650.	Caspar Bauhin "	5,266	"
1704.	Ray "	18,655	"

between species and varieties.

1771. Linnæus (see. Richter Cod. Linn.) reckons 8,551 species, of which 7728 are Phanerogams and 823 Cryptogams.

1807. Persoon (Syn. Plant.) reckons 20,000 species of Phanerogams.

1819. P. De Candolle (Theor. El.) reckons 30,000 species of Phanerogams.

1824. Steudel (Nom. Bot. I Ed.) reckons 70,000 species of Phanerogams and Cryptogams.

1841. Steudel (Nom. Bot. II Ed.) reckons 78,000 species of Phanerogams.

1845. Lindley (Veg. Kingd.) reckons 79,837 species of Phanerogams.

1885. Duchartre (Elem. Bot.) reckons 125,000 species, of which 100,000 are Phanerogams and 25,000 are Cryptogams.

* By P. A. Saccardo, translated by Roscoe Pound.

If we wish however to distribute the number of plants according to the principal groups and on the basis of the most recent monographic works, we arrive at the following result:

	NO. SPEC.	
Dicotyledons	78,200	See Durand Index Gen. Phan. 1888. where the numbers are taken from Bentham and Hooker Gen. Plant. 1862-1883.
Gymnosperms	2,600	
Monocotyledons	19,600	
Ferns	2,685	See Hook. and Bak. Syn. Filic. 1868-74.
Equis. Marsil. Lycopod.	565	See Baker Fern Allies 1887.
Mosses	2,303	See Mueller Syn. Musc. 1849-51.
Liverworts	1,641	See Gott. Lind. Nees, Syn. Hep. 1844.
Lichens	5,600	See Krempelhuber Gesch. Lich. 1870.
Fungi	11,890	See Strienz Nom. Fung. 1862.
Algae	6,200	See Kutzing Spec. Alg. 1849.
Total	131,104	

But this number (131,104) is greatly increased by recent and vigorous contributions made especially in the vast field of the Cryptogamia in consequence of the improvements made in the microscope and the increased number of observers. In fact, according to Underwood, the American hepaticologist (cfr. Bot. Gaz. 1892) from 1844 to the present time the number of Liverworts by researches made in more regions of the world has doubled. And as for the Algae according to my learned colleague, G. B. De Toni, upon documents collected by him and in part published in his admirable Sylloge Algarum, the number of species described up to to-day is distributed as follows:

	NO. SPEC.	
Chlorophyceae	2,798	(Syll. Algar. Vol. I, 1889.)
Cyanophyceae	800	about.
Phaeophyceae	1,100	"
Florideae	2,100	"
Bacillariaceae (Diat.)	5,000	(Syll. Algar. Vol. II et seq.)
Characeae	200	
Total	12,178	

Whence it appears that this vast group, too, has doubled since 1849. Then in regard to the Fungi the results obtained in the active and multiplied researches of the last twenty years have surpassed all expectation. The number of species, in fact, reported in Vol. X of my Sylloge Fungorum and which goes to May of the current year, 1892, attains the marvellous sum of 39,663, that is to say, that in thirty years the group of Fungi has almost quadrupled.

We should therefore join to

Sum Total	131,104	(above indicated)
For the Liverworts	1,400	
For the Fungi	27,773	
For the Algae	5,978	
and we have	166,255	

This sum is deduced from positive data and it is annoying that on the other vegetable groups there is no information summing up the latest additions. However, to judge from the most recent botanical periodicals, as the Botan. Jahresbericht, the Botan. Centralblatt, the Monographiae Phanerogamarum, etc., etc., one cannot deny that the Mosses[1] have doubled since 1851 and that the Phanerogams and Ferns have increased almost five per cent.[2]

Thus we shall have:

Sum total preceding	166,255
For the Phanerogams an increase of	5,011
For the Ferns	134
For the Mosses	2,306
Total	173,706

Which sum, then, represents with great approximation the true number of species of plants known up to the present time, that is 105,231 Phanerogams and 68,475 Cryptogams thus distributed:

[1]The celebrated bryologist Schimper in the preface to his Synopsis Muscorum 1860-1876, thought that the Mosses of the whole world, when known, would amount to more than 8,000 species.

[2]The publication of the new and great Nomenclator Plantarum is eagerly awaited, already in part printed at London by the munificence of Darwin. From this one will be able to state exactly the real increase of the Phanerogams in these last years.

	NO. SPEC.
Phanerogams	105,231
Ferns	2,819
Equis., Marsil., Lycopod.	565
Mosses	4,609
Liverworts	3,041
Lichens	5,600
Fungi	39,603
Algae	12,178
Total	173,706

When we consider the many regions which still remain to explore or are imperfectly explored, it is beyond doubt that the number of plants will still increase very greatly. And one may be certain that it will be the number of the cellular Cryptogams which will receive the greater increase, as compared with the higher plants. In fact the perfections of the microscope which permit the convenient study of these most minute productions are, we may say, of yesterday, and the prodigious conquests of these last years, accomplished above all in the field of the Cryptogams are proof of this.

But the chief design that moved me to write this short note regards the probable number of Fungi to appear. From a few hundred forms which were known at the beginning of the century we have jumped, as has been seen, to about 12,000 species in 1862, and to-day we have nearly 40,000 of them. An astonishing progression, which is not explained solely by the increase of investigations, but reveals the enormous and scattered mass of fungous forms. It has been objected by several botanists that the specific autonomy of many Fungi is not founded on a secure basis and that many such species are rather to be considered as "forms of substratum", that is variations of the same species by reason of the different substratum or matrix in which they grow. I do not wish to deny that several admitted species may find themselves in this situation, but it is to be observed that in beings for the most part simple and microscopic the differential characters cannot be of great importance to our eyes, and hence it is necessary to go slowly before refusing them as good, as one must observe principally their constancy.

After all, on the subject of these suspected forms of substratum, this is a fact worthy of much consideration, that we very often see upon the identical living matrix several species of the same genus maintain themselves, most distinct, although related, as happens, e. g., in the

genera Sphaerella, Diaporthe, Leptosphaeria, Pleospora, Phoma, etc., etc. If the matrix had acted to modify the characters of Fungi, why should we find mingled together on the same branch, on the same leaf, two Diaporthes, two Sphaerellas, perfectly distinct? I am therefore convinced that a reduction of species will have without doubt to be made, but always with great caution, retaining also on this subject the just precept: melius est distinguere quam confundere.

In the number of the Fungi are comprised also the so-called imperfect forms (Sphaeropsideae, Melanconieae, Hyphomyceteae) which amount to about 10,000 species. These, in the judgment of some mycologists, ought to be excluded from the census of species; but this does not seem just, because, if for some few we know for certain that they form part of the metagenetic cycle of known perfect forms, it is more certain still that of the greatest part we know nothing positively of their metagenesis and are able to suspect that they are permanent forms of which the perfect state either has disappeared, or is wanting or is very rare. Why then should we exclude from the census of fungi beings distinct and constant?

We have seen that in only thirty years the number of fungi has increased by almost 28,000 species. I may add that an increase of certainly 8,100 species belongs to the brief period from 1882 to 1890 (cfr. Suppl. Syl. Fung.) in spite of the fact that my Sylloge Fungorum was published contemporaneously, a repertorium of all the Fungi hitherto described. Now we ask ourselves: to what results will the already well-begun mycological researches lead us when we have extended them to the whole world and to all fungus-bearing hosts? Some example can perhaps enlighten us a little on this journey still to be made. One of the best known regions (although not perfectly) in respect to the Phanerogamic flora more than the Cryptogamic, is without doubt the Venetian region. In this, according to the enumeration made by the well known Professor De Visiani in his work of 1869 (Catalogo delle piante vascolari del'veneto) we have 2939 Phanerogams, a number which even to-day remains almost unchanged. For the Cryptogams we have the accurate work of the G. Bizzozero published in 1885 (Flora Veneta Crittogamica, Ven. 1885), where the Venetian Cryptogams amount in all to about 6,000 of which 4,200 are fungi, a number raised now to about 4,800 by the researches of Professors A. N. Berlese, C. Massalongo, etc.

If the number of Venetian Phanerogams studied diligently from more than a century ago till our own time could not with new studies increase more than a very small number of species, it is positive that

the number of fungi will increase considerably. In fact the Venetian Hymenomycetes were until now scarcely studied and the interior provinces like those of Venezia, Rovigo, Vicenza, Belluno, Udine, which comprise the Alpine region which will give us without doubt a large contribution of new forms, are in a mycological respect almost entirely unexplored. I am therefore convinced that when all the Venetian territory is well explored, we will have at least 7,000 fungi in its Flora, a number which compared to that of the Phanerogams (2,939) surpasses it by certainly $\frac{3}{4}$. According to this proportion if we have to-day more than 105,000 Phanerogams in all the world, the fungi in order to exceed them by $\frac{3}{4}$ ought to ascend to about 245,000. This calculation cannot be accused of exaggeration when we see that the greatest part of the fungi being parasites, a connection between them and the hosts (for the most part Phanerogams) must necessarily exist.

But this is not all. We have rich and accurate repertoria of fungi according to their hosts; as the general one of Westendorp, the one for Venice of Cuboni and Mancini; the very recent one for North America of Farlow and Seymour. A glance at these repertoria shows us at once that there are very many Phanerogams which harbor parasitic fungi by tens and hundreds many of which are exclusive to them. We have moreover careful monographs of the fungi which grow upon the vine (Pirotta, Thuemen), on the Lemon and Orange (Penzig), on the Mulberry (Berlese). Now the fungi which grow upon the vine are according to the last census of Thuemen (1892) in number 595, those on the lemon and orange 190, those on the mulberry 200. When we consider these hosts as generic groups (Vitis, Citrus, Morus) and calculate that for each of these groups alone, on an average, 40 per cent. of the parasitic fungi are exclusive to them (and not wandering or pantogenous) we have: for the genus

Vitis, proper species of fungi	238
Citrus	76
Morus	80

the average of which numbers is 131. Now the genera of greater plants of Phanerogams being, according to Bentham and Hooker 8,417, if we reckon 131 fungi proper for each one of these genera, there results the huge cypher of 1,102,627 parasitic fungi, to which must be added that of terrestrial and non-parasitic (about 11,000) in all 1,113,627. Certainly this number does not appear at all impossible when we think that the data are taken from genera (Vitis, Citrus, Morus) which contains few species in comparison with others (e. g. Solanum, Astragalus, Euphorbia) which possess several hundred more of them, which with-

out any doubt have peculiar fungi. Nevertheless reflecting that several species or groups of plants are notoriously attacked by a less number of fungi; that in certain regions of the globe, whether because of dryness, or because of the scarce vegetation parasitic fungi are also rare;[3] finally that woody natures, as the three taken for data, are habitually more attacked by parasitic fungi than the herbaceous, I believe I shall be held just and in every way conservative in calculating only thirty parasitic fungi, on the average, for each genus of Phanerogams. We have thus 252,510 species of parasitic fnngi, which united to the recorded non-parasitis amount to a total of 263,510. The number of parasites (252,510) divided among all the known species of Phanerogams (105,000) would give us the reasonable number of a little more than two special fungi for each phanerogamic host, without counting that also the ferns, mosses, liverworts, and even the greater fungi, offer an asylum to not a few fungous parasites.

This calculation deduced from the number of fungi for each generic group of Phanerogams accords more than sufficiently with the calculation previously made from the connection of the number of species of Phanerogams and that of fungi in a given area well explored, in a way that makes it appear that the total number of species of fungi, perfect and imperfect, in the whole world ought to ascend at least to the neighborhood of 250,000, that is to say, a little more than six times the number we know to-day.

To summarize, we may conclude that the species of plants known and described up to the present time are about 174,000, divided into 105,000 Phanerogams and 69,000 Cryptogams, that is in the lump 50,000 more than were admitted even in recent works. As regards, then, the entire number of species which cloak our globe, by the calculations alone which I have previously explained regarding the fungeous vegetation, I think we shall not go astray in estimating that the Flora of the world when it is completely enough known, will consist of at least 385,000 species of plants (that is, 250,000 fungi and 135,000 species of the other groups). If one wish only to reduce to 15,000 the species which will appear in these other groups (not fungi) the sum total of plants would ascend to 400,000 species at least.

[3] Mycologic geography and statistics are still little advanced. However if we see Europe almost in every part rich in fungi, if we see Argentina and Brazil, Cuba and the United States, Australia and New Zealand, Siberia, Ceylon, and Algiers varyingly but yet always rich in fungi, this signifies that they are liberally diffused at least over a great part of the world.

When shall we come to know well this enormous number of plants? If since 1824 the sum of plants has jumped from 70,000 according to Steudel, to the modern sum of 174,000, that is in 68 years we have discovered 104,000 species, to arrive at a problematical 400,000 about 150 more years of research ought to run. Our remote grandchildren will see whether these prophecies are verified, or whether in this we are greatly in error.—P. A. SACCARDO. [In Atti Cong. Bot. Int. 1892. Translated by Roscoe Pound.]

New Book on Ferns.—A book on the "Study of the Biology of Ferns by the Collodion Method," by Professor G. F. Atkinson of Cornell University is announced for early publication It is to be fully illustrated from original drawings by the author, and will include in the descriptive portion a discussion of the development, morphology and anatomy of the gametophytic and sporophytic phases, while a second part deals with methods of study. The house of Macmillan & Co. is to bring out the book, which will be looked for with interest by laboratory botanists.—CHARLES E. BESSEY.

ZOOLOGY.

Reappearance of the Freshwater Medusa, Limnocodium sowerbii.—Mr. E. Ray Lankester reports finding well-grown specimens of *Limnocodium sowerbii* in the Victoria Regia tank of the Sheffield Botanic Gardens. This jelly-fish was first noticed in 1880 in Regent's Park, to which it had probably been transported from Brazil on the rootlets or leaves of a Pontederia. It was observed from year to year until 1891, when all trace of it was lost, and naturalists gave up the hope of carrying on any further investigation into its life history. Its appearance in Sheffield is accounted for by presuming that some reproductive germs were attached to the water plants sent from Regent's Park to re-stock the tank in Sheffield, April 4, 1892, and April 7, 1893. The curious thing is that in 1892 and 1891 no Limnocodium were seen in the original source, nor in 1893 except the few sent from Sheffield and placed there by Mr. Sowerby.

This beautiful little organism was first studied by E. Ray Lankester, who ascertained the following facts.

The jelly-fish appear suddenly each year as early as April or as late as August, and remain from five to twelve weeks, when they die down and absolutely disappear. When first seen they are extremely minute, $\frac{1}{30}$ of an inch in diameter, and gradually develop to the full size of half an inch in diameter. Of the many hundred specimens examined in successive years, every one without exception were males. They produced abundant motile spermatozoa, but not a trace of egg-cell has ever been found in any one of them.

In 1884 Dr. A. G. Bourne described a diminutive polyp, not more than $\frac{1}{8}$ of an inch long, devoid of tentacles which he found adhering to the root filaments of Pontederia in the same tank in which the Limnocodium was discovered. This polyp was supposed to be the "trophosome" of the Limnocodium medusa. That this inference was true was proved Dr. Fowler in 1890, who was fortunate in seeing the little spherical young found floating in the tank, nipped off by a process of transverse fission from the free ends of the minute polyps described by Bourne.

The next question, How do the polyps originate? has not yet been answered. They increase by budding, but never form colonies of more than four "persons."

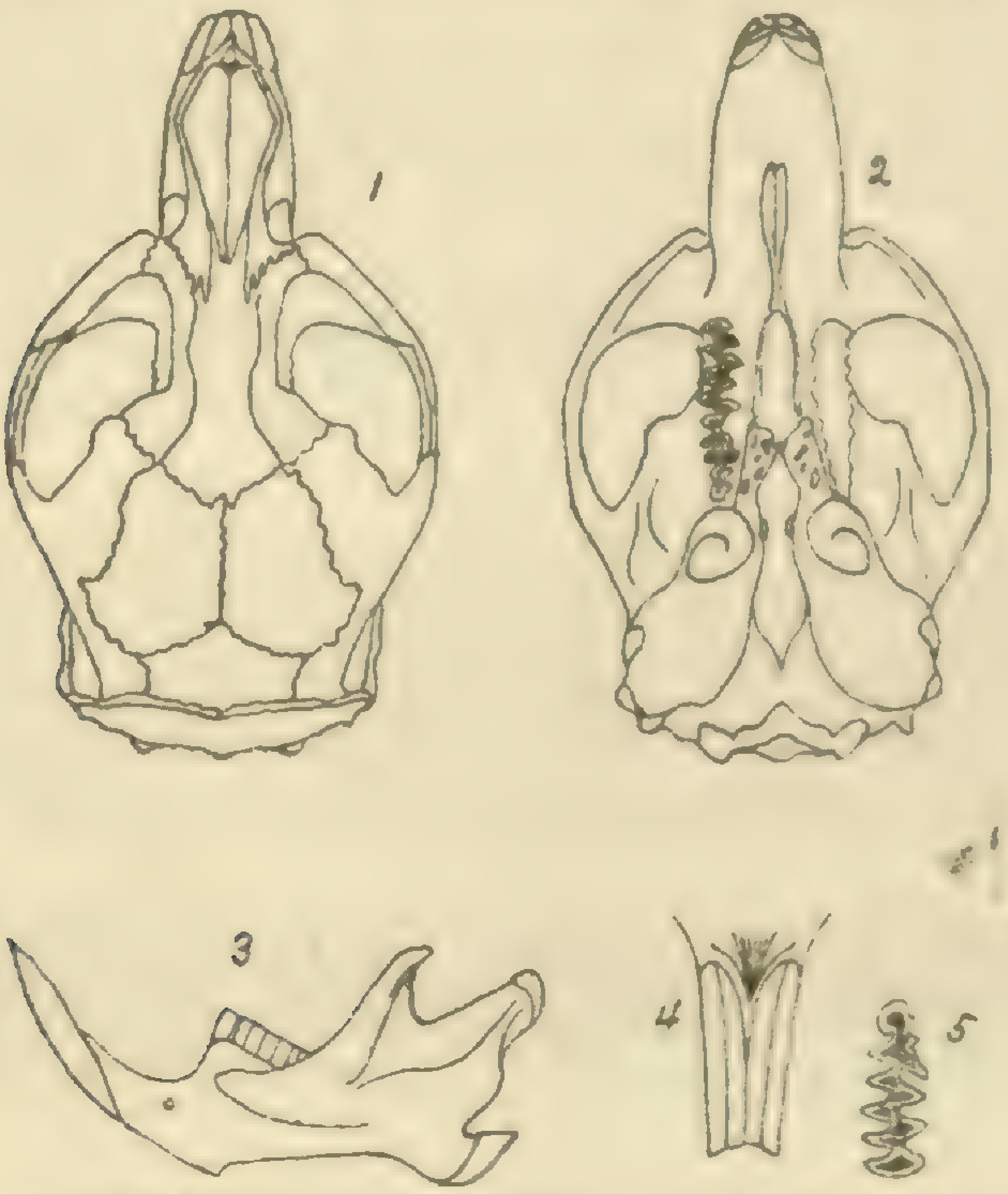
In conclusion, the author refers to the remarkable form worked out

by Mr. R. T. Günther during last winter, the *Limnocnida tanganyisicæ*, a fresh water jelly-fish from Lake Tanganyika. Individuals of three kinds are described by Mr. Günther, viz.: males, females, and asexual individuals which produce crops of buds on the manubrium While differing from Limnocodium in most respects, Limnocnida agrees with it in the minute structure of the marginal sense organs, According to Mr. Lankester no light is thrown by Limnocnida on the problem of the life history of Limnocodium. (Nature, Dec. 7, 1893.)

The American freshwater hydroid *Microhydra ryderii* Potts, is supposed to be a near ally Limnocodium.

Description of a New Genus and Species of Arvicoline Rodent from the United States, Rhoads, Gen. et. sp. nov. (Lake Kichelos, Kittitas County, Washington.)—AULACOMYS ARVICOLOIDES.—*Diagnostic Characters*—Skull large, massive, angular: malars parallel. Superior incisors long and slender (about equalling length of nasals), projecting anteriorly, strongly recurved and with flattened faces. A narrow, longitudinal sulcus equally divides the anterior face of each superior incisor, this groove, slightly magnified, showing a clear-cut, well-defined channel. To the naked eye this channel can be detected only on closest scrutiny. First lower molar with six angles on each side, two isolated triangles on the outer, and three isolated triangles on the inner side. On the inner side these are made up: 1, an inner posterior angle or shoulder of the anterior loop; 2, a rounded angle widely separated from the first but basally connected therewith by a continuous valley and reaching nearly as far from the median line as angle No. 3; 3, 4 and 5, large equidistant acute triangles of equal size, much larger and longer than opposing outer triangles and separated therefrom by a zigzag median line of enamel forming the alternating bases of opposing series of triangles: 6. the inner angle of posterior loop. Exteriorly the angles are formed as follows: 1. a rounded corner at the outer base of anterior loop; 2. a small angle abutting on the extended valley of anterior loop, said angle being anterior to plane of angle (No. 2) of the opposite side; 3. a rounded angle, widely separated from angle No. 2 of same side, due to the extreme posterior deflection of the crescent-like loop which angle No. 3 terminates; this loop is connected by a narrow valley with the anterior loop and in like manner with its preceding angle on the the same side and the two opposing angles, the five angles thus connected representing the four normally present in the anterior trefoil of recent *Arvicola, Evotomys, Synaptomys, Myodes* and *Cuniculus*; 4 and 5.

Two triangles of equal size, their bases formed by the median line of enamel connecting the bases of the three larger opposing internal triangles already mentioned; 6. A rounded angle of the posterior loop distinctly separated from its preceding triangle (No. 5) by full width



AULACOMYS ARVICOLOIDES, Type.

Explanation of Plate.—1. Skull, from above. 2. Same, from below. 3. Exterior of left Mandible. 4. Anterior view of superior Incisors. 5. Crown of right, lower first Molar. (Figs. 1, 2, 3 & 4 x 1½ diameters; fig. 5 x 2½ diameters).

of base of last inner triangle. The molar series are prismatic and non-rooted, Remainder of molar dentition much as in the genus *Arvicola*. Owing, however, to the greater relative depth and width of the entrant angles in *Aulacomys* the basal corners of opposing triangles of the lower molar series do not overlap as in *Arvicola* but stand distinctly upon their respective sections of the median enamel wall. Frontal bones flattened superiorly and lacking trace of supraorbital ridges. Nasals, short, abruptly triangular, terminating posteriorly in a point, very broad anteriorly and deeply notched subterminally. Nasal process of premaxillary, reaching behind anterior plane of orbits, far behind base of nasals and terminating in a slender point. Auditory bullae, triangular, narrow, not encroaching on basisphenoid, the tympanic process of the meatus (viewed from below) lying within lateral profile of the brain case. Postpalatal notch acute, terminating the hastate pterygoid fossa, so formed by the contraction of the pterygoids. Con-

dylar ramus short and heavy with strong posterior shoulder forming a knob at base of condyle, containing the greatly extended root of lower incisor. Coronoid process, stout, erect and triangular. Angle very short and massive.

Body probably stouter than in *Arvicola.* Tail over half the length of head and body, sparsely and evenly coated with short spines and terminated by a well-defined pencil of slender hairs. Feet five-toed, each with five tubercles; claws long and slender. Whiskers pronounced, the longest reaching behind ears.

Aulacomys has the superficial appearance of *Arvicola* but with a very long and apparently naked tail and heavy whiskers. Cranially, it combines the molar dentition of *Arvicola* with the incisor dentition of *Synaptomys.* In these very respects, however, it differs from both genera—from *Arvicola* in the five-angled formation of the anterior section of the first lower molar, and from *Synaptomys* in the length, narrowness, protrusion and *central* sulcation of the upper incisors, also in the extension of the roots of the lower incisors far beyond the last molar.

The dentition of *Aulacomys* shows, in the number of angles of the anterior lower molar, an approach to the extinct form, *Arvicola (Anaptogonia) hiatidens* Cope, from the bone caves of Pennsylvania[1] but differs radically from it in the isolation of the triangles.

The absence of supra-orbital ridges, the posterior prolongation of the nasal premaxillary processes beyond nasals, the acute post-palatal notch, the shape of the pterygoid fossa and the massiveness of the posterior members of mandible are all, in a greater or less degree, diagnostic of *Aulacomys* as distinguished from other Arvicoline genera.

Specific characters.—Type, No. 1358; Ad., ♀. Col. of S. N. Rhoads, Lake Kichelos, Kittitas Co., Washington [Alt. 8,000 ft.], September, 1893. (Col. by Allan Rupert.)

Description.—Characters as decribed for genus. Above, reddish-brown, lined with black. Pelage, basally, everywhere plumbeous. Below, hoary plumbeous, lightest on throat. Upper parts of feet blackish. Tail very slightly darker above, than below. Ears not prominent, well-haired on both sides and with distinct valvular antitragus. Whiskers black.

Measurements (taken in flesh by collector).—Total length.—197;[2] tail 70; (taken from damp, relaxed skin), hind foot 27; ear 10; pencil 7.

[1]Proc. Soc. Amer. Philos. 1871, P. 91.

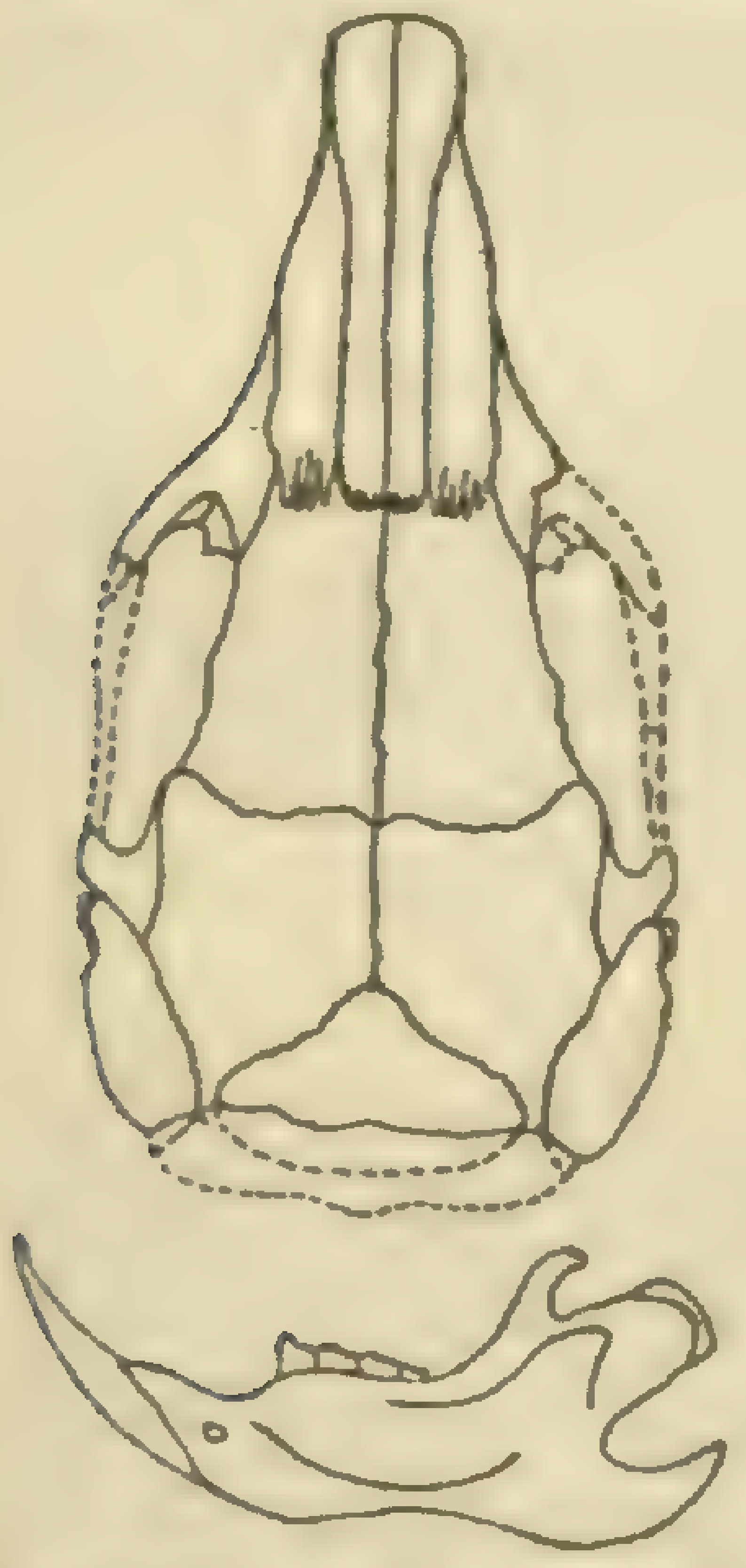
[2]Millimeters.

Skull.—Basilar length 29; total length (occipito-nasal) 31; zygomatic breadth 19; nasal length 9; interorbital constriction 5; interparietal breadth 7; interparietal length 4.9; crown length of molar series 7.4; greatest depth of cranium 10.9; length of mandible 20; height of coronoid process 11; ratio of zygomatic breadth to basilar length 65.5; zygomatic breadth to occipito-nasal length 58.

The specimen on which the foregoing characters are based was taken near Snoqualmie Pass on the Cascade Mountains. Out of a large series of rodents from this district it is the only specimen of its subfamily. It arrived in the form of a flat skin, reversed, with the skull separate and intact.—Samuel N. Rhoads.

Description of a New Perognathus collected by J. K. Townsend in 1834. Perognathus latirostris. Sp. Nov.—Type, No. 694, ad ♂, Col. of Acad. Nat. Sci. of Phila.; "Rocky Mountains, J. K. Townsend;" Summer, 1834.)

Description—(mounted specimen, lacking tail, once preserved in spirits).—Largest known species of the genus. Upper half of head and body to root of tail, brownish-yellow, interspersed medially with black, spinous hairs, becoming purer brown on sides and bordered laterally from base of nose to tail with a broad ill-defined line of pure fulvous. No black tips to brown hairs of back, all hairs being unicolor from root to tip; black hairs coarsest. Pelage long and coarse throughout. Whiskers, slender, sparse, the longest reaching far behind the ears. Lower parts, feet, forelegs to shoulder, and inside of hind legs, dirty white. Ears pronounced, rounded, rather sparsely haired, with marked antitragus not higher than broad at base. Hind ears and spot over eyes fulvous. Hairs of base of tail same color as under parts all round point of fracture, seeming to indicate a unicolor tail. Soles hairless along median line to heel. Cheek pouches very large, external opening of same stretching from upper incisors half way to forelegs.



Perognathus latirostris, Type. (Enlarged one and two-sevenths diameters.)

Skull—(occipital and postero-mastoid region absent); cranium deep, slightly arched, as viewed from above, subrectangular; rostral portion very wide; interparietal bluntly mucronate anteriorly; coronoid pro-

cess erect, abruptly recurved near the blunt tip, anterior width of nasals nearly twice that of posterior width ; a broad supraorbital furrow laterally borders the brain case from the lachrymals to the mastoid side of parietals, audital bullae separated anteriorly by full width of basi-sphenoid, molariform dentition as in *P. paradoxus.*

Measurements—(from mounted specimen) ; length of head and body 145 ; hind foot (shrunken), 27 ; ear from crown, 6.

Skull.—total length (approximate) .35 ; tip of nasals to interparietal 28.4 ; base of incisor to anterior tip of audital bullae 18 ; zygomatic width (at outer bases of squamosal process of malar) 17.5 ; interorbital constriction 8.8 ; length of nasals 14 ; nasal width (near tip) 4.2 ; nasal width (near base) 2.2 ; interparietal width 8.2 ; crown length of upper and lower molar series 4.6 ; length of median parietal suture 5 ; greatest parietal length (masto-squamosal) 10 ; length of mandible (inner base of incisors to condyle) 17.4 ; height of coronoid process from angle 8 ; greatest depth of cranium 11.

The specimen from which the above description is taken was collected by J. K. Townsend during his memorable Rocky Mountain journey nearly sixty years ago. It has been exhibited in the museum of the Academy during the greater part of that period and has lost its tail in the service. The locality given on the present label is only approximate, if correct at all, as an earlier entry of the specimen (probably copied from the original one) in the catalogue gives the specimen as "694, Thomomys rufescens, yg., J. K. Townsend, Columbia River." This name was, a long while ago, altered to "*Perognathus fasciatus*," as the museum label now stands. Probably the person making the last identification changed the given habitat to "Rocky Mountains" to accord with the habitat assigned to *fasciatus* by Baird. The specimen was probably taken east of the 34th meridan and south of the 43rd parallel, in Nebraska or Wyoming. It is not impossible that it came from a more western region. Its differentiation from its nearest ally, *P. paradoxus,* indicates a different faunal habitat from that occupied by the latter. Dr. Townsend makes no mention of the genus *Perognathus* in his list of the mammals observed during his journey, nor does Dr. Bachman, in his supplementary list of novelties published in the Journal of the Academy of Natural Sciences. It is possible that the specimen, owing to its mutilated (tailless) condition and being put in alcohol, was hastily overlooked, or classed as a young *Geomys* (the catalogue entry implies this), and later on it was mounted as such.

The specimen is over-stuffed, but does not appear unduly stretched laterally. From its appearance and the dimensions of its skull it is

evidently a larger species than *paradoxus*, the largest of the genus hitherto known. In many respects, notably of the dentition and general proportions of the brain case, and in size and coloration, *latirostris* resembles *paradoxus*, but is strikingly different in the size and proportions of the rostrum and of the interparietal. Owing to the loss of occipital portions I am unable to give the usual ratios for sake of comparison with Dr. Merriam's tables. *Perognathus latirostris* belongs to the *paradoxus* group of the subgenus *Chætodipus.*—SAMUEL N. RHOADS.

Zoological News.—MOLLUSCA.—The experiments in oyster culture carried on at Roscoff, France, have been extremely satisfactory. In a communication addressed to the Academy of Sciences at Paris, M. de Lacaze Duthiers gives a detailed statement of what has been accomplished. The spat were planted in a closed fish pond so situated that at high tide the sea water could find entrance. The young oysters grew rapidly, and in three years, that is to say the fourth year of their age, they were well grown and fine in flavor. During this year, young were produced in large quantities, thus settling the question of the age for reproduction in the oyster. (Péches Maritimes, T. I, 1893.)

ARTHROPODA.—Mr. Walter Faxon reports 105 new species of Crustacea, some of which represent new genera, in the collection obtained by Mr. Agassiz in the dredging carried on by the U. S. Fish Commission Steamer, "Albatross," off the west coast of Central America and Mexico and in the Gulf of California, during 1891. (Bull. Harvard Mus. Comp. Zool., Vol. XXIV, 1893.)

According to Dr. C. O. Porat, the Syrian Myriopods collected in 1890 by Dr. Barrois comprises 19 species, many of which are new, distributed among 10 genera. In its general aspect this Syrian fauna resembles that of southern Europe and northern Africa, being intermediate in its characteristics. The species are described and figured in Revue Biologique, Nov., 1893.

VERTEBRATA.—The report of the U. S. Fish Commission for 1889–91 contains a review of the Sparoid fishes of America and Europe, by D. S. Jordan and B. Fesler. The family comprises about 55 genera and some 450 species, all valued as food, chiefly inhabiting the shores of warm regions. The authors consider the group closely allied to the Serranidæ on the one hand, the genus Xenistius being very close to the Serranoid genus Kuhlia; on the other hand, Scorpis, Cyphosus, etc., approach the Chætodontidae. Of the 12 subfamilies into which the

group is divided, 3 are exclusively American, and 2 are confined to the Old World.

M. Leon Vaillant describes a new genus of fishes from the Caroline Islands of which there are now two individuals at the Paris Museum. This fish resembles Fierasfer of Cuvier, but differs from it in the size of the dorsal fin, and more particularly in the character and position of its scales. In the Caroline genus the scales are distinctly separate, large in proportion and form a sort of network with lozenge-shaped meshes over the body; they are not imbricated, but merely touch, end for end. It is this singular arrangement of the scales that leads Mr. Vaillant to create a new species to which he refers these fish with the specific name *Rhizœketicus carolinensis.* (Revue Scientifique, Dec. 1893.)

A list of the Mammals of Rio Grande de Sul published by Dr. Herman von Ihering shows the following distribution: Marsupialia 11; Diplarthra 8; Cetacea 2; Edentata 6; Glires 24; Chiroptera 17; Carnivora 19; Pinnipedia 2; Quadrumana 3. (Rio Grande de Sul, 20, IV, 1892.)

From certain cranial and dental peculiarities, Mr. C. Hart Merriam considers the Yellow Bear of Louisiana a species distinct from *Ursus americanus* Pallas and *U. horribilis* Ord. He gives a description based on five skulls from Morehouse Parrish, Louisiana, and claims for it the name *U. luteolus*, given by Griffith in 1821. (Proceeds. Biol. Soc. Wash., Dec., 1893.) He thinks it is the Cinnamon Bear of Audubon and Bachman, but of this there is much doubt.

Two new species are added to the list of Mammals from East Africa, a dormouse, *Eliomys parvus,* closely resembling *E. kellenii*, and a mouse, *Mus tana,* allied to *M. musculus.* Both species are described by Mr. Frederick True in the Proceeds. U. S. Natl. Mus., 1893.

ENTOMOLOGY.[1]

North American Proctotrypidæ.—Mr. Wm. H. Ashmead furnishes in his Monograph of North American Proctotrypidæ,[2] one of the most important of recent descriptive works on American insects. In preparing the 457 pages of his text the author has had ample opportunities to work up our rich Proctotrypid fauna, studying in addition to the various American collections those of the Royal Museum of Berlin. Mr. Ashmead believes that the Proctotrypidæ are more closely allied to the Chrysididæ and Cynipidæ than to the Chalcididæ, next to which they are so commonly placed. He would separate the Mymarinæ as a distinct family allied to the Chalcids.

The lives of adult Proctotrypids are of short duration, not longer than four or five days in confinement, though probably longer under natural conditions. They occur in a great variety of situations, the favorite resorts of some being moist places where vegetation is luxuriant and insect larvæ abundant; others are found along the borders of woods or in the open fields; still others frequent fungi, and some occur in ant's nest. Comparatively few are found on flowers.

"There is scarcely any doubt but that many of the wingless forms to be found in various genera of this family are only dimorphic forms of winged species, although comparatively little is postively known on the subject." The eggs of these insects are "ovate or oblong in shape, with a more or less distinct peduncle at one end, and agree well in general with many in the family Ichneumonidæ, although those in the subfamily Platygasterinæ, on account of the longer peduncle, more closely resemble those in the family Cynipidæ." The larvæ are internal feeders, and in pupating plan for a protection of some kind.

"The Proctotrypidæ are apparent widely distributed over the whole world, although outside of Europe little is known of the exotic forms, and it is not possible therefore to generalize upon the genera and their distribution. From an examination of various exotic collections of Hymenoptera, it is safe to predict the species will be found to be numerous and widely distributed, but far less numerous than the Chalcididæ; judging from my own collecting I should say less than one-fiftieth in number. Only a small percentage of the species is yet described." The affinity of North American forms with those of

[1]Edited by Prof. C. M. Weed, Durham, N. H.

[2]Bull. 45, U. S. Natl. Museum, Washington, 1893.

Europe is shown by the way they fit into established European genera. South American species have required the erection of many new genera.

A large number of new species are described in the present monograph, which concludes with a full Bibliography and eighteen original plates illustrating structural details of members of the various genera.

Peculiar Oviposition of an Aphid.—During the autumn of 1890 I found a species of *Phyllaphis* on beech in central Ohio, the oviparous form of which agrees with Buckton's short description and figure of *P. fagi*. I presume that it is that species, but do not think the present evidence justifies a definite reference to that effect. The colonies were found on the underside of the leaves, with more or less flocculent matter about them. The sexed forms developed during October, and the oviparous females wandered over the bark of the twigs, limbs, and trunk in search of crevices in which to deposit their eggs. When a

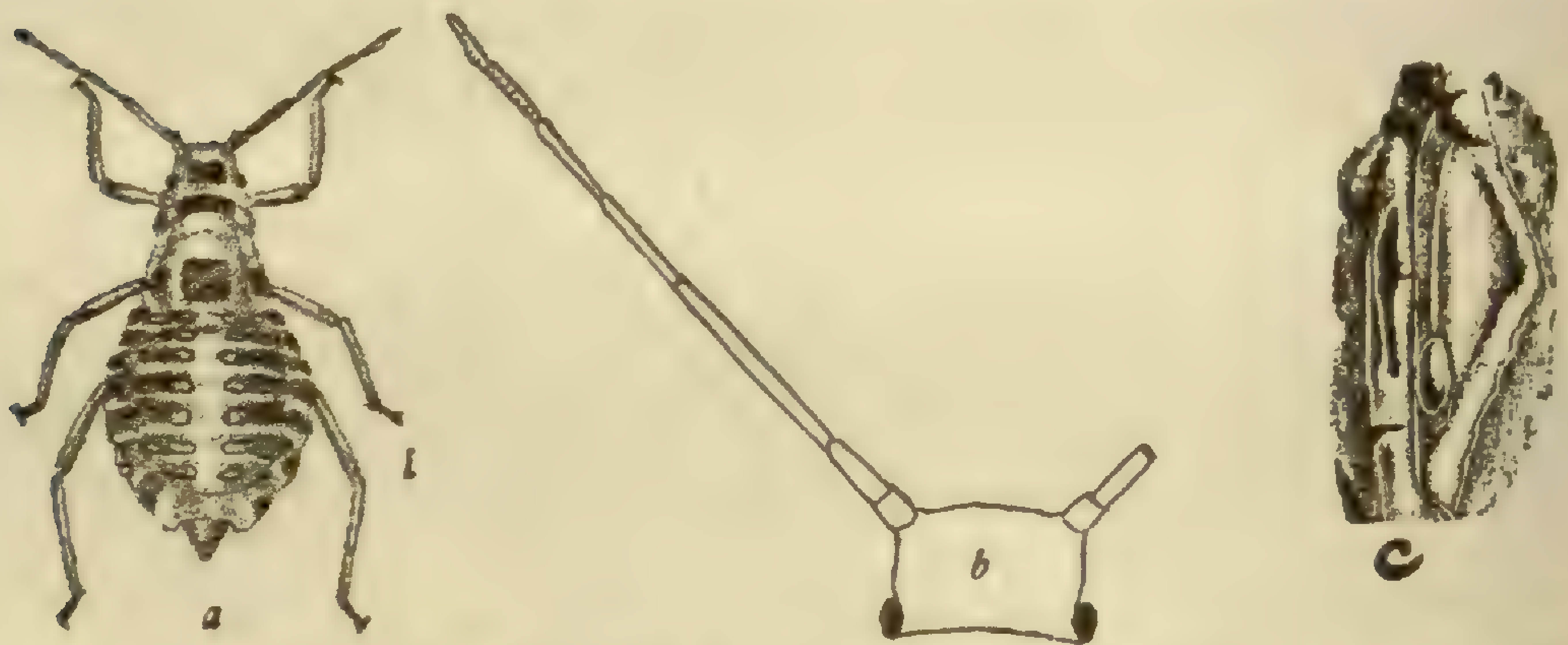


Fig. 1.—***Phyllaphis*** of beech: *a*, oviparous female, magnified; *b*, head and antenna of same, greatly magnified; *c*, egg on bark, magnified.

suitable place is found the egg is laid, and then driven into position by the following method: The insect so places itself that its hind legs easily touch the egg, then standing on its four front ones it brings the two hind ones down upon the egg in rapid succession, striking with considerable force. This serves the double purpose of pushing the egg in place, and of drawing out a viscid secretion, with which it is covered into a thread-like, silvery film, that so resembles the surrounding bark that it is difficult to detect it. I watched an oviparous louse go through this process for about a minute and a half.—*C. M. Weed in Trans. Am. Ent. Society, November*, 1893.

Pupal Development and Color in Imago.—Discussing the recent experiments of Merrifield in which lepidopterous pupæ were submitted to various temperatures and the results on the imagoes noted, Mr. J. W. Tutt briefly recapitulates[1] the well-known facts of histolysis and continues thus: "If we apply the simplest elementary laws relating to vital force to the pupa, we shall find that the following facts hold good:—(1). The pupa when first formed has a certain amount of inherent vital force by means of which both the processes of histolysis and rehabilitation are carried on in it. (2). That pupa which has the nearest approach to the normal amount of vital force will undergo the most perfect histolysis and rehabilitation, and will produce an imago most nearly conforming to what is known as the normal type, that is the type produced under the most healthy and satisfactory conditions. Conversely that pupa whose amount of vital force is farthest removed from the normal (whether in excess or in defect) is one in which histolysis and rehabilitation will be least perfect, and the imago produced will be the farthest removed from the normal type. (3). That individual which has been best fed and which had enjoyed the most perfect health in the larval stage, will enter pupal life under the most satisfactory conditions and will (the pupal conditions being equally satisfactory) emerge therefrom as the best specialized product, whilst the converse to this must also be true.

"The second point also deals with an elementary principle. The vital force in the pupa is converted into energy; the energy at the disposal of the pupa is most probably directed first to the building up of the vital reproductive organs, and afterward to the secondary organs or tissues or such as are not necessary to life. Therefore an excess of energy in a pupa will be expended as a rule on secondary structures rather than on vital ones, and we find that a weak or diseased pupa fails first in regard to non-vital tissues, such as pigment, scales, wing-membrane, etc.

"The females of insects, as compared with the males require an excess of energy for those structures necessary to the reproduction of the species; they, therefore, have a smaller surplus to devote to the formation of the non-vital tissues, and as we well know frequently fail very markedly in their development of these.

"We are now in a position to understand that as a general rule pigment, scales, etc., are produced in proportion to the amount of material and energy available for the purpose.

[1]The Entomologist's Record, IV, 312.

"These and other general principles have to be considered when we attempt to discuss the results which Mr. Merrifield produces by his temperature experiments.

* * * "If now we apply these principles what do we find? Insects which are allowed to pass through their changes at the normal temperature produce the form which is normal for the district; that is they undergo the normal processes of histolysis and of rehabilitation, and in a state of health have at their disposal the energy requisite to give them their ordinary wing expanse, scaling and color. Now what does Mr. Merrifield do in his experiments? He subjects the pupa to a low temperature. This of necessity lowers the vitality of the pupa and so lessens the available energy. The insect therefore does not develop under normal conditions, and an abnormality is the result. The insect must use what energy it has to build up its vital organs, and fails in building up perfectly its secondary tissues—color, scales, wing membrane, and fails to in direct proportion to the degree in which the vitality is lessened. Below a certain temperature during the period of active development the vital force ceases to act at all, and the result is death. Heat, greater than that to which the insect is normally subjected, instead of lowering the vitality to the lowest ebb at which life can be sustained, affects the histolysis and rehabilitation in a directly opposite manner. Under its influence the vital processes are carried on at express speed. Energy is expended at the fastest rate possible, and the tissues are formed without having sufficient time to mature as they would under normal conditions, the surplus material is rapidly utilized, with the result that as marked an abnormality is produced under the one condition as under the other, although in an opposite direction."

Studying Insect Histories.—That the pursuits of the entomologists are not always so delightful as the chasing of June butterflies is shown by the following extract from a paper recently read by Mr. L. O. Howard before the Association of Economic Entomologists: To gain the clearest and most accurate idea of a life history, the insect must be studied under perfectly natural conditions, and not under conditions which more or less imperfectly simulate the natural ones. There is no easy road to the most perfect knowledge of habits. It involves tramping through mud and bramble patches; it involves the constant risk of sunstroke, and in our southern country the constant presence of Leptus and Ixodes (itch-mites and ticks); it involves constant watching and watching and watching, astride the small limb af a fruit tree,

perhaps, on your back under bushes, on your knees in the wheat-field, on your stomach in the pasture, with your face down close to a cow dropping, and with the summer sun beating down upon your unprotected head, watching and watching until the eyes grow dim; but in this way only are the unsolved problems in the life histories of injurious insects most satisfactorily worked out.

Biology of the Apple Aphis.—The common Aphis of the apple (*A. mali*) has for many years puzzled entomologists by its summer history. During June, usually, winged viviparous females leave the apple and disappear. In September other similar forms return to apple and give birth to the oviparous females which deposit the eggs on the twigs. In a paper on the insect foes of American cereals read at the recent meeting of the Association of Economic Entomologists, Mr. F. M. Webster of the Ohio Experiment Station gave a clue to the summer history in the following paragraph:

"It would appear almost visionary to advocate spraying apple orchards in midwinter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of apple during the winter season. I refer to the Apple Leaf-louse (*Aphis mali* Fabr.), Soon after the young wheat plants appear in the fall, the winged viviparous females of this species flock to the fields, and on these give birth to their young, which at once

Apple Aphis; wingless viviparous female. Magnified.

make their way to the roots, where they continue reproduction, sapping the life from the young plants. On very fertile soils this extraction of the sap from the roots has no very serious effect, but where the soil is not rich, especially if the weather is dry, this constant drain of vitality soon begins to tell on the plants. Though they are seldom killed out right these infested plants cease to grow, and later take on a sickly

look, and not until the Aphis abandons them in the autumn to return to the apple, do they show any amount of vigor."

This leaves the summer period still unaccounted for, but in the discussion which followed Mr. Webster's paper, Dr. C. V. Riley stated that he had "for a number of years known that this species had a summer existence on various grasses."[4]

Nematodes in Cecidomyia.—At a recent meeting of the *Société Entomologique de France*, M. A. Girard called attention to the observation of Kieffer[5] as to the existence of Nematode parasites in a female cecidomyiid (*Asynapta citrina* Kieff.). A fly of this species stupified by nitro-benzine emitted from the oviduct a compact mass of Anguillulas which placed in water moved about rapidly. Kieffer thought that the alimentary canal also contained these Nematodes, but Girard believes it to be a case where only the abdomen, especially the region of the ovaries is inhabited by the parasite. He reports a similar observation of his own, in which an undetermined cecidomyiid was the host. The body cavity was nearly filled with a Nematode of the genus Asconema and its embryos. The ovaries of the fly were atrophied by parasitic castration. The eggs of the Nematode developed in the body of the fly, and the latter laid the little Anguillulas in humid situations where they could develop.

Flights of Dragon-Flies.—In Mr. W. H. Hudson's recently published *Naturalist in La Plata* there is an extremely interesting chapter on Dragon-fly Storms. In the Pampas and Patagonia, the larger species of these insects—especially *Æschna bonariensis* Raml., a pale blue form—frequently occur in enormous flocks which appear shortly in advance of a sudden and violent wind—called the *pampero*. "Inasmuch as these insects are not seen in the country at other times, and frequently appear in seasons of prolonged drouth, when all the marshes and water courses for many hundreds of miles are dry, they must of course traverse immense distances, flying before the wind at a speed of seventy or eighty miles an hour. * * * As a rule they make their appearance from five to fifteen minutes before the wind strikes; and when they are in great numbers, the air to a height of ten or twelve feet above the surface of the ground, is all at once seen to be full of them, rushing past with extraordinary velocity in a northeasterly direction. * * * * All journey in a northeasterly direction; and of the countless millions

[4]Insect Life, VI, 152.

[5]Berlin Ent. Zeitsch., XXXVI, 1891, p. 266.

flying like thistle down before the great pampero wind, not one solitary traveller ever returns."

These flights occur during the summer and autumn. Mr. Hudson thinks the cause "is probably dynamical, affecting the insects with a sudden panic, and compelling them to rush away before the approaching tempest. The mystery is that they should fly from the wind before it reaches them, and yet travel in the same direction with it.

* * * On arriving at a wood or large plantation they swarm into it, as if seeking shelter from some swift pursuing enemy, and on such occasions they sometimes remain clinging to the trees while the wind spends its force."

Mr. Hudson calls attention to Weissenborn's observation of a dragon-fly migration in Germany in 1839,[6] and his mention of similar flights in 1816. These occurred in May and the insects flew south.

An autumn flight of dragon-flies among the Alps has been described by W. Warde Fowler[7] whose attention was called to the flight by a waiter in an Alpine hotel. The latter had "observed a constant stream of dragon-flies making their way up the valley; and during my walks that day I was able fully to verify his statement. All the way from Haspenthal to Andermatl these creatures were to be seen coming up *against the wind*, which was now blowing from the west. There was no mistake about it; countless numbers were steadily passing up the valley, but whither they were going it was hopeless to ascertain; they did not seem to turn up the St. Gotthard Road, for I remarked them the whole way up the valley to the foot of the Furka Pass Westwards."

A Carnivorous Tipulid.—Professor L. C. Miall describes[8] the early stages of a crane-fly of the genus Dicranota with aberrant habits for Tipulidæ, the larvæ of which are mostly vegetable-feeders. This larva lives in the bottom of brooks or other water streams and feeds upon the red worms of the genus Tubifex. The head of the larva is small, the alimentary canal straight and the body is provided with spiracles and tracheal gills, so that the animal can breathe in or out of water. Pupation take place in moist soil.

Notes.—Mr. Albert P. Morse begins in the current issue of *Psyche* an important paper on the Wing-lengths of New England Acridiidæ,

[6]Mag. Nat. Hist. n. s,, v. III.
[7]A Year with the Birds, 202.
[8]Trans. Ent. Soc., London, 1893, 235.

and in the same issue Mr. S. H. Scudder publishes some interesting biological notes on American Gryllidæ. With this issue, *Psyche* begins its seventh volume.

Mr. G. C. Davis has prepared an interesting and valuable illustrated paper on insects injurious to celery. It is issued as Bulletin 102 of the Michigan Experiment Station.

Professor Herbert Osborn, Ames, Iowa, has bound together two of his recent papers on injurious Iowa insects which contain much valuable information. He offers a limited number of copies for sale at 30 cents each.

An excellent biographical notice of Dr. H. A. Hagen appears in *Entomological News* for December.

Professor M. H. Beckwith reports[9] that in Delaware during the past season crops of all kinds have been unusually exempt from the attacks of insects. In his summary of the year's work he discusses a number of injurious insects and experiments with remedies. The arsenites were found effective for the plum curculio, and the pyrethro-kerosene emulsion proved an excellent destroyer of aphides.

The last issue of *Insect Life* contains a full report of the Madison meeting of the Association of Economic Entomologists.

[9]Fourth Rept. Del. Ag. Expt. Station, 89–103.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Society of Naturalists.—The 12th Annual Meeting was held in the buildings of Yale University, New Haven, Ct., Dec. 27 and 28, 1893, Professor Chittenden of Yale occupying the chair. The meeting was largely one of business, and the following matters were discussed: A movement was inaugurated whereby a closer union could be effected between the Society of Naturalists and the affiliated societies of Morphologists, of Physiologists and Anatomists. Later the societies of Morphologists and Physiologists accepted the new scheme, which therefore goes into effect, so far as they are concerned, during the present year. It is hoped that later the societies of Psychologists and of Geologists will co-operate in the same way. By the new scheme all meetings will be held at the same time and place and a single notification and a single assessment will answer for all, while membership in one of the affiliated societies will carry with it membership in the Society of Naturalists. Another matter was the appointment of a committee consisting of Professors C. S. Minot of Harvard, S. I. Smith of Yale, H. F. Osborn of Columbia, Wm. Libby, Jr. of Princeton and William H. Howell of Johns Hopkins to appeal to Congress for action which should do away with that tax upon knowledge which is embodied in the customs duties upon instruments of research. It was pointed out that these duties were not needed for the protection of the American manufacturer, for at least in one instance, American firms were ready to afford their goods at a price a little below the foreign manufacturers to those institutions which could obtain duty free prices, while for all others they added the extortionate 65 per cent. of the present tariff. The principal subject for discussion was the present status of our knowledge of the cell, the opening papers being by Prof. R. H. Chittenden of Yale, upon the subject from the physico-chemical standpoint, and by Prof. E. L. Mark from the zoological standpoint. Two illustrated evening lectures were given, one by Prof. L. A. Lee of Bowdoin upon a Comparative Study of Labrador and Patagonia, the other by Prof. Wm. Libby, Jr. upon the Physical Geography of the Hawaiian Islands. At the Annual Dinner some 75 partook. The following officers were elected for the ensuing year: Pres., Prof. C. S. Minot of Boston; Vice Presidents, Prof. S. I. Smith of New Haven, Mr. Wm. H. Dall of Washington, Prof. Wm. Libby, Jr. of Princeton; Secretary, Prof. W. A. Setchell of New

Haven; Treas., E. G. Gardiner of Boston; Committee at large, Prof. H. F. Osborn of Columbia, Dr. C. W. Stiles of Washington.

Society of Morphologists.—The annual meeting of this society was held at New Haven Dec. 28 and 29, 1893. In the absence of Prof. C. O. Whitman, Prof, E. B. Wilson occupied the chair. The following officers were elected for the ensuing year: Pres., Prof. C. O. Whitman of Chicago; Vice Pres., Prof. W. B. Scott of Princeton; Secretary-Treasurer, Dr. G. H. Parker of Cambridge; Executive Committee, Dr. E. A. Andrews of Baltimore and Prof. F. H. Herrick of Cleveland. Professors E. L. Mark of Cambridge and T. H. Morgan of Bryn Mawr were appointed as a committee to co-operate with a similar committee for the Society of Naturalists in the endeavor to secure the placing of scientific instruments upon the free list. The following papers were read: Bashford Dean, the significance of Kuppfer's vesicle. H. H. Wilder, on the Phylogenesis of the larynx. C. W. Stiles, the anatomy of Fasciola magna, and a comparison with other forms (F. hepatica, F. gigantea, and F. jacksoni). F. H. Herrick, the structure and functions of certain organs occurring in the appendages of the Lobster. Arthur Willey, on some points in the development of Molgula manhattensis. C. B. Davenport, on Regeneration of Hydroids. J. P. McMurrich, some points in the development of the Isopod Crustacea. C. S. Minot, apparatus for trimming paraffin blocks C. S. Minot, a comparison of larval and fœtal types of development C. S. Minot, on Gonotomes. C. A. Kofoid, some laws of cleavage as exemplified by Limax and other Invertebrates. H. E. Crampton, reversed cleavage in a sinistral gasteropod. W. A. Locy, the derivation of the Pineal Eye from accessory optic vesicles. Charles Hill, Epiphysis of Teleosts and Amia. G. H. Parker, the structure of the Rhabdome in Astacus. G. H. Parker, the optic ganglion in the Crustacea. W. B. Scott, on some Miocene Mammals, O. S. Strong, a new modification of the Golgi-Cajal method. Miss H. B. Merrill, preliminary note on the eye of the leech. Miss S. F. Langdon, the sense organs of Lumbricus. Dr. E. B. Wilson, a demonstrative object for the study of Karyokinesis.

The following demonstrations were given: C. W. Stiles, exhibition of specimens of Distoma westermanni, Stilesia globipunctata, Stilesia centripunctata, Dracunculus medinensis, Spurious parasites. J. P. McMurrich, Ganglion cells and larva of an ectoparasitic Trematode. O. S. Strong, nerves stained by the Golgi methods. Chas. Hill, Epiphysis of Salmo. F. E. Langdon, Sense organs of Lumbricus.

The Sixth Annual Meeting of the American Physiological Society was held at New Haven, Conn., December 28th and 29th, 1893. The following papers were read: G. D. Goodyle, Concerning the Corrosive Action of Root Hairs. J. W. Warren, on the Zymogen of the Saliva. Wm. A. Setchell, Proteolytic Ferment of Drosera. C. F. Hodge, daily life of a Protozoan, Vorticella gracilis. C. S. Minot, on Growth. W. T. Porter, on Growth of Children. H. G. Beyer, Normal Growth and Physical development of the Human Body. J. H. Pillsbury, Color Sense. C. F. Hodge, a Comparative Study of the Fovea Centralis. E. W. Scripture, some Work on Statistics. Isaac Ott, the Location of the Cerebral Motor Center of the Bladder. F. S. Lee, the Sense of Equilibrium in Fishes. J. W. Warren, a Finger Jerk. H. P. Bowditch, on Muscular Rigor. H. P. Bowditch, on the Effect of varying Rates of Interruption in Nerve. W. H. Howell, the relations of Calcium Salts to the irritability of the Muscle and Nerve. G. Lusk, the Influence of ingested Sugars in Phlorizin Diabetes. P. A. Levene, Preliminary Communication; the Blood in Phloridzin Diabetes. H. E. Smith, Acidity of the Urine. W. Gilman Thompson, Notes on the Physiological Effect of Ozonizing Agents.

The following demonstrations were given: S. J. Meltzer, Demonstration of a Pleura canula. W. G. Thompson, Demonstration of inexpensive Models for teaching purposes. A. P. Brubaker, Demonstration and Determination of the Radius of the Corneal Curvature with the Opthalmometer. W. P. Lombard, Model, showing Effect of Rotation of Ribs.

The Geological Society of America met in Boston, Dec. 27th and 29th, 1893. The following is a list of papers read before it:

Sir J. William Dawson, some recent discussions in geology (Presidential address). George M. Dawson, Geological notes on some of the coasts and islands of Behring Sea and its vicinity. Frank H. Knowlton, Fossil flora of Alaska. Sir J. William Dawson, New discoveries of Carboniferous Batrachians. William H. Dall and Joseph Stanley-Brown, Cenozoic geology along the Apalachicola river. Alfred C. Lane, Geological activity of the earth's originally absorbed gases. William B. Clark, Certain climatic features of Maryland. H. S. Williams, Dual nomenclature in geologic classification. George Huntington Williams, Johann David Schoepff, and his contributions to North American Geology. Bailey Willis, Relations of synclines of deposition to ancient shorelines. Alexander Agassiz, an

account of an expedition to the Bahamas. William B. Scott, Lacustrine Tertiary formation of the west. C. Willard Hayes, Geology of the Coosa valley in Georgia and Alabama. William H. Hobbs, Geological structure of the Housatonic valley lying east of Mt. Washington; read by J. E. Wolff. J. E. Wolff, the Hibernia fold, New Jersey. N. S. Shaler, Tertiary dislocation of the Atlantic coast of the United States. N. S. Shaler, relations of mountains to continents. N. S. Shaler, Phenomena of beach and dune sands. W. M. Davis and L. S. Griswold, Eastern boundary of the Connecticut Triassic. W. M. Davis, Geographical work for state geological surveys. W. M. Davis, Facetted pebbles on Cape Cod. Charles D. Walcott, Paleozoic intra-formational conglomerates. M. R. Campbell, Paleozoic overlaps in Montgomery and Pulaski counties, Virginia. Alpheus Hyatt, the Trias and Jura of the Western States. J. S. Diller, the Shasta-Chico series of the Pacific coast. T. W. Stanton, the Cretaceous faunas of the Shasta-Chico series. Robert T. Hill, Geology of Indian Territory and Texas adjacent to Red river. S. F. Emmons and G. P. Merrill, Notes on the geology of Lower California. William B. Clark, Origin and classification of the greensands of New Jersey. Charles R. Keyes, Crustal adjustment in the upper Mississippi basin. William H. Niles, a geological study of Lake Mohonk and Lake Minnewaska, N. Y. N. H. Darton, Geologic relations in the belt from Green Pond, New Jersey, to Skunnemonk Mountain, New York. Robert H. Richards, a prismatic stadia telescope. George Huntington Williams, Ancient volcanic rocks along the eastern border of North America. C. H. Hitchcock, Ancient eruptive rocks in the White Mountains. G. K. Gilbert, the chemical equivalence of crystalline and sedimentary rocks. William H. Hobbs, Volcanite, an anorthoclase augite rock chemically like the dacites read by G. H. Williams. H. P. H. Brumell, Farther notes on the occurrence of laberite in New Brunswick, Canada. Homer T. Faller, Alterations of silicates in gneiss at Worcester, Mass. Robert Bell, Pre-paleozoic decay of crystalline rocks north of Lake Huron. James F. Kemp, Gabbros on the western shore of Lake Champlain. Robert W. Ells, Notes on the occurrence of mica in the Laurentian of the Ottawa district. Whitman Cross, Intrusive sandstone dikes in granite. James P. Smith, Age of the auriferous slates in the Sierra Nevada. William O. Crosby, Origin of the coarsely crystalline vein granites or pegmatites. William O. Crosby, a classification of economic geological deposits, based upon origin and original structure. R. S. Tarr, Lake Cayuga a rock basin. James E. Todd, Plistocene problems in

Missouri. G. Frederick Wright, Remarks upon a supposed glaciated stone axe from Indiana. T. C. Chamberlin, Pseudo-cols. T. C. Chamberlin and Frank Leverett, Certain features of the past drainage systems of the upper Ohio basin. G. Frederick Wright, Glacial history of western Pennsylvania. F. B. Taylor, the ancient strait at Nipissing. Edward H. Williams, Extramoraine drift between the Delaware and the Schuylkill. Professor Dr. Alfred Teutzsch, Königsberg, Prussia, Interglacial series of Germany. Warren Upham, the Madison type of drumlins. Warren Upham, Diversity of the glacial drift along its boundary. E. O. Hovey, Notes on the microscopic structure of siliceous oölite.

Indiana Academy of Science.—The Ninth Annual Meeting was held at Indianapolis, December 28 and 28, 1893. when the following papers relating to Natural History were read and discussed:

An Alphabetical and Synonymical Catalogue of the Acrididæ of the United States, W. S. Blatchley. On the Hibernation of Turtles. A. W. Butler. Some Notes on a Variety of *Solanum dulcamara*. R. Wes. McBride. Work of the Botanical Division of the Natural History Survey of Minnesota, D. T. MacDougal. Indiana Fishes, C. H. Eigenmann. The Fishes of Wabash County, A. B. Ulrey. Review of Botanical Work in Indiana with Bibliography. L. M. Underwood. Notes on an Imbedding Material, John S. Wright. Recent Notes on Indiana Birds, A. W. Butler. The Distribution of Indiana Birds, A. W. Butler. On the Occurence of the Rarest of the Warblers (*Dendroica kirtlandii*) in Indiana, A. B. Ulrey. Histology of the Pontederiaceæ, E. W. Olive. Growth in Length and Thickness of the Petiole of Richardia, Katherine E. Golden. The Geographical and Hypsometrical Distribution of North American Viviparidæ, R. Ellsworth Call. The Effect of Light on the Germinating Spores of Marine Algæ, Melvin A. Brannon. Notes on Saprolegnia. George L. Roberts. Contributions to the Life-History of Notothylas, D. M. Mottier. Some South American Characinidæ, with Six New Species. A. B. Ulrey. Should the Study of Natural Science in the Lower Classes of the Public Schools be Encouraged. W. W. Norman. The Detection of Strychnine in an Exhumed Human Body, W. A. Noyes. Absorption of Poisons by Animal Tissue After Death, P. S. Baker. Induration of Certain Tertiary Rocks in North-Eastern Arkansas. R. Ellsworth Call. The White Clays of Southern Indiana, A. W. Butler. The Effect of Environment on the Mass of Local Species, C. H. Eigenmann. The Ash of Trees, Mason B. Thomas. Poisonous Influence

of *Cypripedium spectabile,* D. T. MacDougal. Notes on the Biological Survey, Mason B. Thomas. Notes on Sectioning Woody Tissues, John S. Wright. The Stomates of Cycas, Mason B. Thomas. Symbiosis in *Isopyrum biternatum,* D. T. MacDougal. Our Present Knowledge of the Distribution of Pteridophytes of Indiana, Lucien M. Underwood. Concerning the Effect of Glycerine on Plants, John S. Wright. The Adventitious Plants of Fayette County, Robert Hessler. Bibliography of Indiana Ornithology, A. W. Butler. Bibliography of the Batrachians and Reptiles of Indiana, O. P. Hay. Bibliography of Indiana Mammals, A. W. Butler and B. W. Everman

The President's address by Dr. J. C. Arthur discussed "The special senses of plants."

Natural Science Association of Staten Island, Nov. 11th, 1893. Mr. William T. Davis exhibited specimens of *Anodonta fluviatilis* Lea, and read the following memorandum:

Rediscovery of Anodonta fluviatilis on Staten Island.—During the past summer *Anodonta fluviatilis* was found in the Bull's Head pond. Only empty shells were discovered, chiefly such as had been opened and their contents eaten by musk rats. Mr. Sanderson Smith has informed me that, as far as he remembers, the specimens admitted into the list of fresh and salt water shells of the Island, originally published in the Annals of the New York Lyceum of Natural History, in May, 1865, and subsequently republished with a few changes, in our Proceedings, as Extra No. 5, March, 1887, came from the ponds near Clifton. None have been reported in many years, so the present specimens from Bull's Head are worthy of being placed on record.

Mr. Arthur Hollick exhibited specimens of drift bowlders, containing fossils, from Prince's Bay, and read the following memorandum:

A Recent find of Drift fossils at Prince's Bay.—On the 29th of last month, while examining the Drift rocks at the base of the Prince's Bay bluff, I found four bowlders containing fossils, representing four different geological horizons, viz.: Hudson shale, with *Orthis,* probably *O. testudinaria* Dal; Helderberg limestone, with *Strophodonta beckii* Hall, *S. varistriata* Conr. *Strophomena rhomboidalis* Wahl. and *Orthis oblata* Hall; Oriskany sandstone, *Spirifera arrecta* Hall; Schobarie grit, with *Atrypa reticularis* L. and fine specimens of some Bryozoon not determined. By far the larger part of the bowlders was left behind and will receive further attention on some future occasion. These do not add any new species to our already published lists of Drift

fossils, except in the case of the provisionally determined *Strophodonta varistriata*, but the discovery, in one day, in a very limited area, of four fossiliferous bowlders, representing as many different geological horizons, is perhaps worthy of note.

The Biological Society of Washington, Jan. 13, 1894.—Communications: Dr. Theo. Gill, the Segregation of the Osteophysarial Fishes as Fresh water Forms. Mr. Robt. T. Hill, a new Fauna from the Cretaceous Formations of Texas. Dr. C. W. Stiles, the Teaching of Biology in Colleges. Mr. J. N. Rose, a Botanical trip to Northwestern Wyoming.

SCIENTIFIC NEWS.

The death is announced at Paris of the biologist Dr. Chabry, known for his work in experimental teratology.

M. Paul Fischer, the conchologist of the Museum d'Histoire Naturelle, died Nov. 29, 1893. He contributed largely to the literature of science, his Histoire des Mollsques du Mexique being, perhaps, the best known of his works.

Dionys Stur, late director of the K. K. geologische Reischsanstalt of Austria, died at Vienna, Oct. 9th, 1893.

The loss to zoology by the recent death of Prof. Milnes Marshall, of Owens College, Manchester, England, is not easily estimated. There is a striking similarity in the manner of his death and that of his instructor, the lamented. Marshall was climbing one of the peaks ef Scfeawll, in Cumberland, when his foot slipped, and he fell over a precipice. His death occurred June 31, 1893.

A prize of 1,800 francs is offered by the Italian Geological Society for the best memoir on the present knowledge of the paleozoic and mesozoic formations in Italy. This paper will follow one by D'Archiac entitled " History of the Progress of Geology ", and must be presented before the end of March, 1896.

Dr. Harrison Allen has been appointed director of the Wistar Institute of Anatomy of the University of Pennsylvania.

The Owen's Memorial Committee has entrusted the statue of the late Sir Richard Owen to Mr. T. Brock, R. A.

The late Professor Newberry's name is to live in a fund which the scientific societies of New York have resolved to raise, It will be called the John Strong Newberry fund, be not less than $25,000, and the income derived from it will be devoted to the encouragement of scientific work in geology, paleontology, botany and zoology. Professor N. L. Britton is secretary to the subscription committee.

Professor Ben. K. Emerson, of Amherst College, and of the U. S. Geol. Surv., who met with a serious railway accident last summer, and was reported killed, has so far recovered that he has started on a trip around the world for rest and recuperation. He visits Italy, Egypt, India, Java and Japan. Prof. Emerson has been engaged for a long time in mapping the crystalline rocks of Central Massachusetts and Connecticut.

A member of the Anthropological Society of Washington has placed in the hands of the Treasurer of the Society a sum of money to be awarded in prizes for the clearest statements of the elements that go to make up the most useful citizen of the United States, regardless of occupation. The donation has been accepted, and the Society has provided for the award of the following prizes during the present year (1893) under the following conditions:

Two prizes will be awarded for the best essays on the subject specified above, viz: A first prize of $150 for the best essay, and a second prize of $75 for the second best essay among those found worthy by the commissioners of award.

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Each essay should bear a pseudonym or number, and should be accompanied by a sealed envelope bearing the same pseudonym or number, and containing the name and address of the competitor: and the identity of the competitors shall not in any way be made known to the Commissioners of Award.

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Pueblos and Cliff Dwellers, by J. Walter Fewkes, of the Hemingway Expedition, Mr. A. M. Stephens, of Keam's Canon, and others. Also on the "Characteristics of the American Languages," by Dr. D. G. Brinton, Prof. Ed. Seler and others. Also on the Myths and Folklore, by Mr. James Deans and the Rev John McLean. Mr. A. Perry, of London, England, Mrs Zelia Nuttall and G. A. Dorsey will write upon Mexican and Peruvian Antiquities. There will be articles on the ASIATIC or POLYNESIAN ORIGIN of the American Indians, and on Prehistoric Contact with Other Continents, by Dr. Cyrus Thomas, Hon. James Wickersham and C. Staniland Wake and on certain "Bronze, Copper and Rare Stone Relics" which have recently come to light, by Dr. J. D. Butler, J. R. Sutter, H. I. Smith, William R. Seever, and S. H. Montgomery. Notes on

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Reichert's Hæmometer. (Illustrated.) F. Gaertner, M. D.
The Microscope and Its Accessories. (Illustrated.) The Editor.
A Device to take the place of the Camera Lucida in Micrography. (Illustrated.) H. G. Piffard, M. D.
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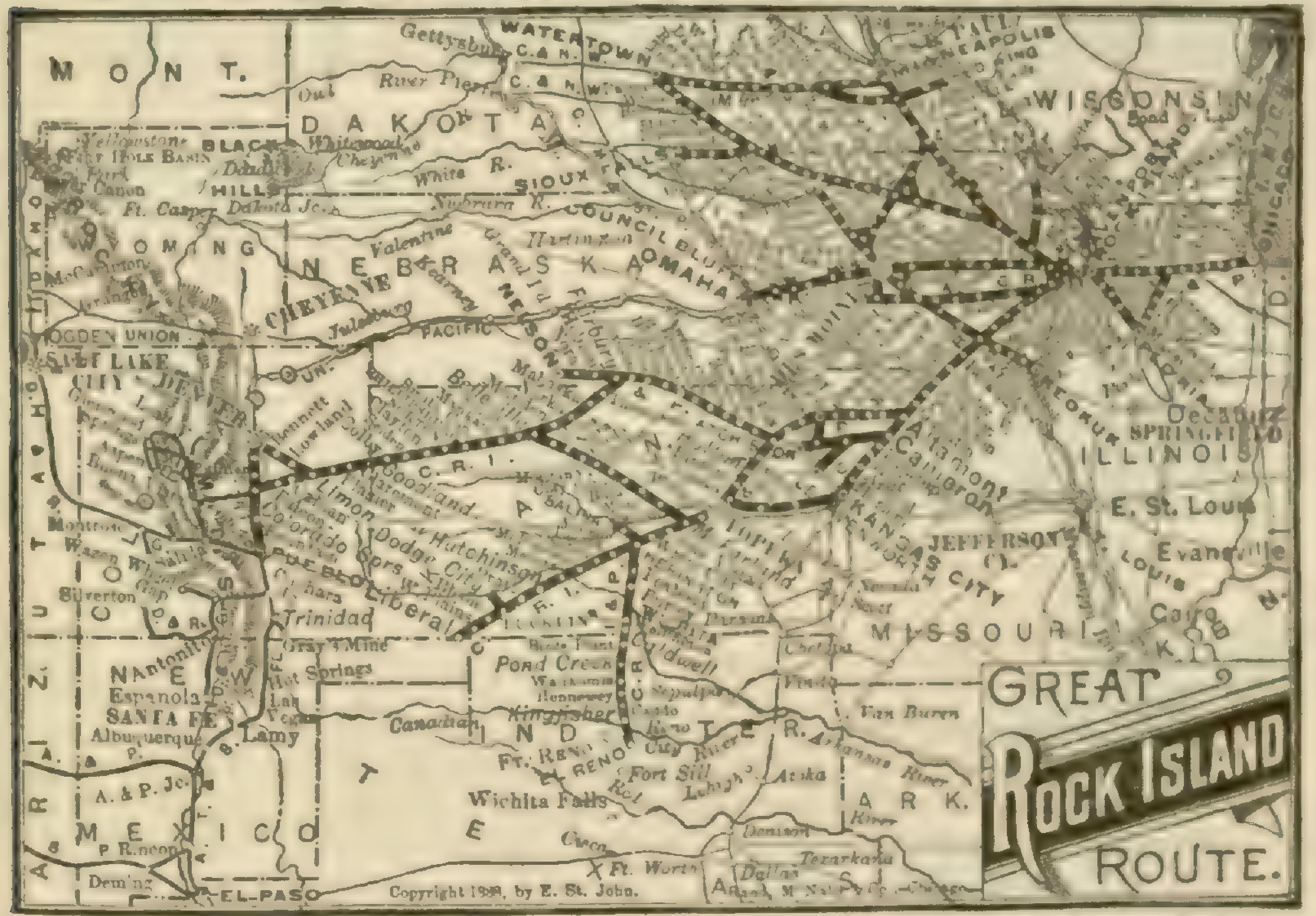

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THE ENERGY OF EVOLUTION.

By E. D. Cope.

1 Preliminary.

In considering the dynamics of organic evolution, it will be convenient to commence by considering the claims of Natural Selection to include the energy which underlies the process. That Natural Selection cannot be the cause of the origin of new characters, or variation, was asserted by Darwin;[1] and this opinion is supported by the following weighty considerations.

(1) A selection cannot be the cause of those alternatives from which it selects. The alternatives must be presented before the selection can commence.

(2) Since the number of variations possible to organisms is very great, the probability of the admirably adaptive structures which characterize the latter having arisen by chance is extremely small.

(3) In order that a variation of structure shall survive, it is necessary that it shall appear simultaneously in two individuals of opposite sex. But if the chance of its appearing in one individual is very small, the chance of its appearing in two individuals is very much smaller. But even this concurrence of chances would not be sufficient to secure its survival, since it would be immediately bred out by the immensely prepon-

[1]Origin of Species, Ed. 1872, p. 65.

derant number of individuals which should not possess the variation.

(4) Finally, the characters which define the organic types, so far as they are disclosed by paleontology, have commenced as minute buds or rudiments, of no value whatsoever in the struggle for existence. Natural Selection can only effect the survival of characters when they have attained some functional value.

In order to secure the survival of a new character, that is, of a new type of organism, it is necessary that the variation should appear in a large number of individuals coincidentally and successively. It is exceedingly probable that that is what has occurred in past geologic ages. We are thus led to look for a cause which affects equally many individuals at the same time, and continuously. Such causes are found in the changing physical conditions that have succeeded each other in the past history of our planet, and the changes of organic function necessarily produced thereby.

2 Bathmogenesis.

If we view the phenomena of organic life from the standpoint of the physicist, the first question that naturally arises in the mind is as to the kind of energy of which it is an exhibition. Ordinary observation shows that organic bodies perform molar movements, and that many of them give out heat. A smaller number exhibit emanations of light and electricity. Very little consideration is sufficient to show that they include among their functions chemical reactions, a conviction which is abundantly sustained by researches into the physiology of both animals and plants. The phenomena of growth are also evidently exhibitions of energy. The term energy is used to express the motion of matter, and the building of an embryo to maturity is evidently accomplished by the movement of matter in certain definite directions. The energy which accomplishes this feat is, however, none of those which characterize inorganic matter, some of which have just been mentioned, but, judging from its phenomena, is of a widely different character. If we further take a broad view of the general

process of progressive evolution, which is accomplished by successive modifications of this growth-energy, we see further reason for distinguishing it widely from the inorganic energies.

It is customary to distinguish broadly between inorganic and organic energies, as those which are displayed by non-living and living bodies. This classification is inexact, since, as already remarked, nearly all of the inorganic energies are exhibited by living beings. A division which appears to be, with our present knowledge, much more fundamental, is into the energies which tend away from, and those which tend towards, the phenomena of life. In other words, those which are not necessarily phenomena of life, and those which are necessarily such. And the phenomena of life here referred to are the phenomena of growth and evolution, as distinguished from all others. I have termed[2] these classes the Anagenetic, which are exclusively vital, and the Catagenetic, which are physical and chemical. The Anagenetic class tends to upward progress in the organic sense; that is, toward the increasing control of its environment by the organism, and toward the origin and development of consciousness and mind. The Catagenetic energies tend to the creation of a stable equilibrium of matter, in which molar motion is not produced from within, and sensation is impossible. In popular language the one class of energies tends to life; the other to death.

That the Catagenetic energies whether physical or chemical, tend away from life is clear enough. Thus molar motion unless continuously supplied, or directed by a living source, speedily ceases, being converted by friction into heat, which is dissipated. And were we to suppose a case where friction is non-existent, motion would remain molar, and no phenomena of organic life would result, and sensation could not arise. The same is true of molecular movements under the same conditions. Chemical reactions, which are fundamental in world-building, result in the production of solids and the radiation of heat. The most familiar example, that of oxydation, presents us with the case of a gas becoming a liquid

[2] The Monist Chicago, 1893, p. 630.

or a solid with the evolution of heat. The endothermic reaction, where matter undergoes a change of molecular aggregation the reverse of that just mentioned, with the absorption of heat, as in the case of several hydrogen compounds, is rare in nature, where free from organic complications, and is generally soon reversed by further reactions. Finally cosmic creation involves the perpetual radiation of heat into space, and the gradual reduction of all forms of matter to the solid state.

In the anagenetic energies, on the other hand, we have a process of building machines, which not only resist the action of catagenesis, but which press the catagenetic energies into their service. In the assimilation of inorganic substances they elevate them into higher, that is more complex compounds, and raise the types of energy to their own level. In the development of molar movements they enable their organisms to escape many of the destructive effects of catagenetic energy, by enabling them to change their environment; and this is especially true in so far as sensation or consciousness is present to them. The anagenetic energy transforms the face of nature by its power of assimilating and recompounding inorganic matter, and by its capacity for multiplying its individuals. In spite of the mechanical destructibility of its physical basis (protoplasm), and the ease with which its mechanisms are destroyed, it successfully resists, controls, and remodels the catagenetic energies for its purposes.

The anagenetic power of assimilation of the inorganic substances is chiefly seen in the vegetable kingdom. Atmospheric air, water and inorganic salts furnish it with the materials of its physical basis. Then from its own protoplasm it elaborates by a catagenetic retrograde metamorphosis, the mostly non-nitrogenous substances, as wood (cellulose), waxes, oils and alkaloids, and it may take up inorganic substances and deposit them without alteration in its cells. Many of the compounds elaborated by plants and animals have been manufactured of latter time by chemists. The discovery that the living organism is not necessary for the production of these substances has led to the hasty conclusion that the supposed distinction between "organic" and "inorganic" energy does not exist. But the

elaboration of these substances is not accomplished by anagenetic or "vital" energy, but by a process of running down of the higher compound protoplasm, which is catagenesis. No truly anagenetic process has yet been imitated by man.

All forms of functioning of organs, except assimilation, reproduction and growth, are catagenetic. That is, functioning consists in the retrograde metamorphosis of a nitrogenous organic substance or proteid with the setting free of energy. The proteid is decomposed in the functioning tissue into carbon dioxyd, water, urea, etc., and energy appears in the muscle as contraction, in the glands as secretion, and in all parts of the body as heat. The general result of physiologic research is, that the decomposition of the blood is the source of energy, while the tissue of each organ determines the character of that energy. That the tissue itself suffers from wear, and requires repair, is also true, but to a less extent than was once supposed.

In the anagenetic process of the growth of the embryo the case is different. Here the processes of functioning of organs are in complete abeyance, the nutritive substance is not entirely broken down in chemical decomposition, but it is in great part elaborated into tissues and organs. All the mechanisms necessary to the mature life of the individual are constructed by the activity of the special form of energy known as growth-energy or Bathmism. It is the modifications of this energy which constitute evolution, and it is these to which we will hereafter direct our attention. Its simplest exhibition is the subdivision of a unicellular protoplasmic body into two or more individuals or structural units of a multicellular organism. Further division of the latter does not abolish the individual, but extends it, and we now observe the elaboration of different structural types to become a conspicuous function of this form of energy. In other words a once simple energy becomes specialized into specific energies, each of which, once established, pursues its mode of motion in opposition to all other modes not more potent than itself. Besides the evident truth of the proposition than a mode of building is a mode of motion, we have another very good reason for believing in the existence

of a class of bathmic or growth-energies. This is found in the phenomena of heredity. The most rational conception of this inheritance of structural characters is the transmission of a mode of motion from the soma to the germ-cells. This is a far more conceivable method than that of the transmission of particles of matter, other than the ordinary material of nutrition. The bathmic theory of heredity bears about the same relation to a theory of transmission of the pangenes of Darwin, or the ids of Weismann, as the undulatory theory of light and other forms of radiant energy does to the molecular theory of Newton. I have therefore assumed as a working hypothesis the existence of the bathmic energy, and will enquire how far the facts in our possession sustain it. In doing so it will be necessary to elaborate the theory so as to render clearer its application to specific cases. The fact to be accounted for is its specialization into so many diverse specific forms.

A further indication of the existence of the bathmic energy is the quantitative limitation to which growth is obedient. Thus the successive stages of embryonic growth are limited in number in each species. The dimensions of many species are limited within a definite range. The duration of life, or of the functioning organic machine, has a definite limit in time. All this means that a certain limited quantity of energy is at the disposal of each individual organism.

In "The Origin of the Fittest," I have endeavored to show what causes have been and are efficient in the production of different types of organic life, through the modifications of the bathmic energy. We will now briefly consider to the question of the origin of the living substance, protoplasm or sarcode, which exhibits bathmism.

If the tendency of the catagenetic energies is away from vital phenomena, it is impossible that they, or any one of them, should be the cause of the origin of living matter. This logical inference is confirmed by the failure of all attempts to demonstrate spontaneous generation of living organisms from inorganic matter. Further, the principle of continuity leads us to infer that the energy which produced organic matter must be identical with or allied to that which is the efficient agent in pro-

gressive evolution of organisms, and is, therefore, anagenetic. Such a conclusion may seem to lead to a dualism which is itself opposed to the principle of continuity or uniformity, and which is opposed to experience of the phenomena of energy in general. How is uniformity to be harmonized with the hypothesis of two types of energy acting in different directions, apparently in opposition to each other? Since facts and logic do not support the derivation of the anagenetic from the inorganic energies, can the reverse process, the derivation of the catagenetic from the anagenetic be and have been the order of nature? In support of this hypothesis, we have the universal prevalence of the retrograde metamorphosis of energy in both the inorganic and organic kingdoms. Phenomena of structural degeneracy are well known in the organic world, and purely chemical phenomena in both organic and inorganic processes are all degenerate. It appears then much more probable that catagenesis succeeds anagenesis as a consequence, and does not precede it as a cause. In other words, it is more probable that death is a consequence of life, rather than that the living is a product of the non-living. I have therefore given to that energy which is displayed by the plant in the elaboration of living from now living matter the name of antichemism.[3] Thus while the heat of the sun is necessary to the building of protoplasm, within a certain range of temperature, this form of energy has its opportunity.

In order to present more clearly the views enunciated in the preceding pages, I give a synoptic table of energies.

I Anagenetic	Organic	Antichemism.
		Bathmism.
II Catagenetic	Exclusively organic	Neurism.
		Myism.
	Inorganic	Radiant Energy.
		Chemism.
		Cohesion.
		Gravitation.

3 The Forms of Bathmism.

The innumerable structures which are due to the activity of Bathmisms may be supposed to result from the composition of

[3] American Naturalist, 1884, p. 979. Origin of the Fittest, 1887, p. 431.

this energy with others which are present in the organism or in the environment, or both. Ryder has called the exhibition of growth energy Ergogenesis,[4] and he calls attention to the fact that it appears under two aspects. In the first, Ergogenesis is due to mechanical causes resident in the organism exclusively, and it expresses the sum of the bathmic energy inherited from the parents of the growing organism. To this conservative expression of Bathmism he gives the name of Statogenesis. In the second aspect of Ergogenesis, the course of growth (ontogeny) is determined by motion from sources external to the germ cell. It is this which modifies ontogeny and produces those changes of structure which constitute Evolution. To this aspect of growth I have given the name Kinetogenesis.[5] As Statogenesis expresses simple growth force, and Kinetogenesis the additional growth, which is evolution, the latter is chiefly considered here.

Kinetogenesis is of two kinds; viz., the changes in growth which are due to the interference of molecular energies only, and those which are due to molar movements. The former type of evolutionary growth I propose to call Physiogenesis; and I propose to restrict the term kinetogenesis to the latter class. To the total evolutionary energy or energies due to external interference, the Kinetogbnesis of Ryder, I propose to apply the term Bathmogenesis. The relation of these modes, and their corresponding names may be expressed as follows:

Ergogenesis { Statogenesis
Bathmogenesis. { Physiogensis.
Kinetogenesis.

Statogenesis, I shall hereafter endeavor to show, is an automatic product of Bathmogenesis.

The first step in the order of Bathmogenetic action is the effect of stimuli on an animal which is no longer protected by the parent or by parental products (egg-shell) as an embryo. Changes may be effected in the weight, color, and in functional

[4] Proceeds. Amer. Philos. Soc. 1893, p. 194.

[5] Origin of the Fittest, 1887, p. 423. Statogenesis and Kinetogenesis are the equivalents of my Growth Force and Grade Growth Force, Proceeds. Amer. Philos. Soc. 1871, p. 258.

capacity by temperature, humidity, food, etc., thus exhibiting physiogenesis. Or changes in the size and form of parts of the body may be produced by movements of the organism, or of its environment, so displaying Kinetogenesis. So long as these modifications of structure should be confined to the individuals thus modified, there would be no evolution. A second generation, if not subjected to the same stimuli, would not possess the modifications; and their possession of them would depend entirely on the amount of stimulus. In other words there would be no accumulation of modification. It has, however, been generally believed that these modifications are inherited, and I think it can be shown that this belief rests on a solid basis. Meanwhile I call the Bathmogenesis which does not extend beyond the generation in which it appears, autobathmogeny.

The quantitative relation which necessarily exists between Bathmism and its sources may be expressed as follows, with due recognition of the fact that such expression does not rest upon any experimental tests. Statogenesis is work done in the construction of tissues like those of the parent and without interference. Here we have the molecular energy of the parent (either as protozoon or oösperm) temporarily converted in part into the molar movements observed to be concomitants of segmentation; to be represented in the completed tissue by the mutual tensions by virtue of which each structural element maintains its integrity. It is evidently a process of metamorphosis of energy in which there is less waste than in any other known to us. Embryonic growth is accompanied by a very slight dissipation of heat, though a slight rise of temperature is noticeable in the eggs of cold-blooded animals and in flowers, when reproduction is active. The products of breaking down are equally rare in embryonic growth, and both this and the dissipation of heat are evidently largely due to the changes wrought in non-cleavable nutritive substances with which the yolks are sometimes charged. It is probably to accomplish this process that the oxygen necessary for the embryonic growth is used. How much loss is due to cell division itself

is not known, but it must be very little if any. We have here a nearly perfect conversion of energy. Theoretically we have anagenesis wherever the up-building exceeds the down-breaking.

The attempt to realize in the imagination the modus operandi of bathmic energy in embryo building takes the following form. It is to be supposed that movement which has been most frequently repeated, and for the longest period, is prepotent, and takes precedence of all others. This is clearly simple cell division, which follows the nutrition supplied by the spermatozoön, and which represents the first act of animal life. Hence, segmentation of the oösperm is the first movement of bathmism. Each subsequent movement appears in the order of potency, which is, other things being equal, a time order, or the order of record. The cause of the localization of tissues and structures is much more difficult to understand than the cause of the order of their appearance. The more energetic part of the process naturally requires the greater space for its products. The ectoderm, which becomes the seat of the nervous axis and its muscular adjuncts, occupies the superficial portions of the yolk. Hence, we may regard this expression of the structural record of these functions as more energetic than that of the record structure of the nutritive functions, which displays itself below the ectoderm. In meroblastic and amphiblastic embryos, the segmentation which develops the nutritive tissues is evidently more sluggish, for the cells are larger and fewer in number than those of the ectoderm.

Can this difference in the segmentations which produce the ectoderm and the endoderm be due to a certain polarity; the male or energetic tendency predominating in the former, and the female in the latter?

External stimuli modify the course of statogeny above described, and by producing new structural records cause a new form of energy, due to composition of the new with the old, and the process of growth then becomes bathmogeny. The external stimuli are molecular or molar, determining physiobathmism or kinetobathmism.

The effect of motion or use on the soma may be conveniently termed autokinetogenesis. Moderate use of a muscle is known to increase its size. Irritation of the periosteum is known to cause deposit of bone. Friction and pressure of the epithelium increases its quantity or changes its form. Increased activity of the functions of nervous tissues increases their relative proportions, as in the enlargement of nerves which replace others which are interrupted by mutilations, etc. On the other hand, it is equally well known that disuse produces diminution of muscular tissue, and through it, a reduction in the quantity of the harder tissue (bone, chitin, etc.) to which it is attached, (as muscular insertions, etc.). It was the observation of such well-known phenomena as these that led Lamarck to advance his doctrine of evolution under use and disuse, and which has led many others to give their adherence to such a view.

Thus much for cell-growth. Another class of modifications of a similar kind may be found in the parts of an organism which consist of a complex of cells, or tissues. Thus the lumen of a small artery is enlarged under the influence of pressure when it is compelled to assume the function of a larger vessel through the interruption of the latter. A part of an internal or external skeleton which is fractured will form an artificial joint at the point of fracture, if the adjacent surfaces are kept in motion. Marey (Animal Mechanism pp. 88–89) says " After dislocations the old articular cavities will be filled up and disappear, while at the new point where the head of the bone is actually placed, a fresh articulation is formed, to which nothing will be wanting in the course of a few months, neither articular cartilages, synovial fluid, nor the ligaments to retain the bone in place." I have given some illustrations of this fact,[6] which have come under my observation, and which have an important bearing on the origin of the articulations of the vertebrate skeleton as I have traced them throughout geological time. I have as I think conclusively shown that these varied structures have been produced by impacts and strains, which are concomitants of the movements of the animals, acting through long periods of time.[7] I have also proposed the

[6] Proceeds. Amer. Philos. Soc. 1892, p. 285.

[7] Mechanical Origin of the Hard parts of the Mammalia, Amer. Journal of Morphology, 1889. Origin of the Fittest, 1887, pp. 305-373.

hypothesis, that such Kinetogenetic organic energies as are not under the control of the organism, are the product of the catagenesis of energies which were at one time under such control.

4 Mnemogenesis.

The above term is employed by Prof. Hyatt[8] to characterize the manner in which kinetogenesis is supposed to produce results in inheritance. I have suggested that the phenomena of recapitulation, characteristic of ontogeny (Amer. Naturalist, Dec., 1889), are due to the presence of a record in the germ cells, having a molecular basis similar to that of memory. This view is adopted by Professor Hyatt. I have already referred to it in the preceding pages. The stimuli which are thus recorded are those which produce growth effects in the body or soma, so that each stimulus may have a double influence. For this reason I have termed this theory of the distribution of energy, Diplogenesis (loc. cit.).

The first statement of the mnemonic theory of heredity which I can discover, is that made by Hering in 1870.[9] It is concentrated in the following paragraph: "The appearance of properties of the parental organism in the full-grown filial organism can be nothing else but the reproduction of such processes of organized matter as the germ when still in the germinal vesicles had taken part in; the filial organism remembers, so to speak, those processes, as soon as an occasion of the same or similar irritations is offered a reaction takes place as formerly in the parental organism, of which it was then a part and whose destinies influenced it." In explanation of this theory Hering says: "We notice, further on, that the process of development of the germs which are destined to attain an independent existence, exercises a powerful reaction upon both the conscious and unconscious life of the whole organism. And this is a hint that the organ of germination is in closer and more momentous relation to the other parts, especially to the nervous system, than another organ. In an inverse ratio the conscious and unconscious destinies of the whole organism,

[8] Proceeds. Boston Soc. Nat. Hist. 1893, p. 73.

[9] Address before the Imperial Academy of Sciences of Vienna, May 30, 1870, by Edwald Hering.

it is most probable, find a stronger echo in the germinal vesicles than elsewhere."

It is evident that evolutionists are reaching greater harmony of opinions on the question of inheritance, for both sides are adopting the doctrine of Diplogenesis. In fact, the discussion is beginning to be a logomachy dependent on the significance which one attaches to the term, "acquired characters." Thus, Vom Rath, who says he does not believe in the inheritance[10] of acquired characters, remarks: "there is nothing in the way of the opinion that by the continual working of such external influences and stimuli, the molecular structure of the germ-plasma also experiences a change which can lead to a transmission of transformations. Above all, it ought not to be forgotten in this case that the somatic cells are in no way the first to be modified by the stimulus, and that then by some sort of unexplained process (pangenesis or intercellular pangenesis) this stimulus is transmitted generally by these cells to the plasma of the germ cells. The influence on the germ-plasma is rather a direct one, and if by continued influence a transformation of the structure of this plasma takes place and transmission occurs, we have then simply a transmission of blastogenic and by no means of somatogenic characters, and therein is not the slightest admission of the transmission of acquired characters."

This surprising paragraph contains an admission of the doctrine of Diplogenesis, and does not regard the phenomena as including a transmission of acquired characters. Nevertheless, the stimuli traverse the soma in order to reach the germ plasma. Such an energy is evidently then not of blastogenic origin, although it is such in its effects. Moreover, Vom Rath omits to mention the fact that in traversing the soma, the stimulus frequently, if not always, produces effects on the latter similar to those which it produces on the germ plasma. I should call this process the inheritance of an acquired character, even in the case where no corresponding modification appears in the soma, since the causative energy is acquired by the soma, and is not derived from the existing germ plasma.

[10]Berichte der Naturforsch. Gessel. zu Freiburg Baden. Bd. VI, H. 3.

Romanes[11] says, in revising the opinions of Weismann, "(1) Germ Plasm ceases to be continuous in the sense of having borne a perpetual record of congenital variations from the first origin of sexual propagation. (2) On the contrary, *as all such variations have been originated by the direct action of external conditions*" (italics mine) "the continuity of the germ plasm in this sense has been interrupted at the commencement of every inherited change during the phylogeny of all plants and animals, unicellular as well as multicellular. (3) But germ plasm remains continuous in the restricted though highly important sense of being the sole repository of hereditary characters of each successive generation, so that acquired characters can never have been transmitted to progeny, 'representatively,' even though they have frequently caused those 'specialized' changes in the structure of the germ plasm, which, as we have seen, must certainly have been of considerable importance in the history of organic evolution."

Here the inheritance of characters acquired by the soma is admitted, and the process is after the method of Diplogenesis. According to Romanes, Galton originally propounded this doctrine. Galton's language[12] is as follows:

"It is said that the structure of an animal changes when he is placed under changed conditions; that his offspring inherit some of his change, and that they vary still further on their own account, in the same direction, and so on through successive generations until a notable change in the congenital characteristics of the race has been effected. Hence, it is concluded that a change in the personal structure has reacted on the sexual elements. For my part, I object to so general a conclusion for the following reasons. It is universally admitted that the primary agents in the processes of growth, nutrition and reproduction, are the same, and that a true theory of heredity must so regard them. In other words, they are all due to the development of some germinal matter variously located. Consequently, when similar germinal matter is everywhere affected by the same conditions, we should

[11]An Examination of Weismannism, Chicago, 1892, p. 169.

[12]Contemporary Review, 1875, pp. 343–4; Proceeds. Royal Soc., 1872, no. 136.

expect that it would be everywhere affected in the same way. The particular kind of germ whence the hair sprang that was induced to throw out a new variety in the cells nearest the surface of the body under certain changed conditions of climate and food, might be expected to throw out a similar variety in the sexual elements at the same time. The changes in the germs would everywhere be collateral, although the moments when any of the changed germs happen to receive their development might be different." This is the first statement of the doctrine of Diplogenesis with which I have met and it appears to me to furnish the most rational basis for the investigation into the dynamics of the process.

THE CLASSIFICATION OF THE ARTHROPODA.

BY J. S. KINGSLEY.

(*Continued from page* 135, *February, 1894.*)

SUB-CLASS II—EUCRUSTACEA.

Crustacea, with filiform, plumose or lamellate gills, in either thoracic or abdominal region; mouth parts never ambulatory in the adult, but modified for the prehension and comminution of food. Nauplius stage either free-swimming or passed in the egg.

It is difficult, with our present knowledge, to find good diagnostic points separating the true Crustacea from the Trilobites, and it may be that further research will show that the latter are to be regarded as a division equivalent to some of those mentioned below. At present, the arrangment of the feet of the cephalic region in a circle around the mouth, the use of their basal joints for the comminution food, and the apparent functioning of the distal joints as locomotor organs, together with the peculiar gills, must serve to differentiate the two groups, it being understood that the ideas here expressed are merely provisional.

In the sub-division of the Crustacea I am inclined to adopt the recent "sub-classes" of Grobben ('92) as super-orders as follows:

Super-Order I, Phyllopoda.
  Order I, Euphyllopoda.
  Order II, Cladocera.
Super-Order II, Estheriæformes.
  Order I, Ostracoda.
Super-Order III, Apodiformes.
  Order I, Copepoda.
  Order II, Cirripedia.
Super-Order IV, Malacostraca sive Branchipodiformes.

I, Leptostraca.
Order I, Nebaliadæ.
II, Eumalacostraca.
Order I, Stomatopoda.
Order II, Thoracostraca.
Order III, Arthrostraca.

On the whole, I accept the conclusions of Grobben as to the relationships of the various groups, and have, like many other zoologists, regarded the Phyllopods as the ancestral stock. I think that this is shown by, among other points, the structure of the appendages, regarding which I fully accept the conclusions of Lankester[2] ('81). I do not regard the nauplius stage as indicative of a naupliform ancestor, but as an introduced feature, for which view the arguments adduced by Claus and Dohrn, seem valid. The ancestor of the Phyllopods must have been an elongate poly-somitic animal with lamellate appendages, the basal portions of one or more "legs" serving at the same time as both locomotor and manducatory organs. In short, my views as to the ancestral form are much like those adopted by Bernard ('92), although I cannot accept all of his conclusions as to the steps of the evolution.

Class II—Acerata.

Branchiate Arthropods, in which the branchial folds, developed from the abdominal appendages function as gills, as lungs, or as tracheæ. The body is divided into cephalothorax and abdomen, the line passing behind the sixth pair of appendages. The genital ducts open upon the first abdominal somite. The anterior postoral ganglia unite to form a ganglionic ring aronnd the œsophagus; the median eyes are in-

[1] I regard Packard's ('87) Syncarida as a group of Amphipoda of scarcely more than family rank.

[2] Grobben does not accept Lankester's views, and claims that embryology shows that Lankester's sixth endite is the endopodite and the flabellum the exopodite, in support of which he cites the observations of Claus ('73, p. 20). I cannot find there or anywhere else in Claus' paper any evidence which is not capable of being interpreted in full harmony with Lankester's view that the 5th and 6th endites of the Phyllopod limb are endopodite and exopodite respectively, while the flabellum is the homologue of the epipodite of the "typical" Crustacean limb.

vaginate. The entoderm (at least in several types) arises by delamination; there is a large mid-gut, with well-developed glands ("liver") while the proctodeum is short. The genital glands are reticulate and the spermatozoa are motile.

There is little to be said upon the foregoing points, to which many more, applicable to both Xiphosures and some Arachnids, might be added. The exact serial correspondence of the respiratory metameres in Limulus and the Scorpions have been enlarged upon by Lankester ('81[a]), and considerable emphasis must be placed upon the fact that in all Arachnids the stomata are ventral, and are, in all instances, except in possibly the Solpugids and a few mites, are confined to the abdomen. These exceptions need new study. In the Scorpion, as in Limulus, the observations of Narayanan ('89) and Laurie ('90) show that the genital ducts are modified nephridia, and that they open upon the posterior surface of the first abdominal appendages. Delamination has been shown to occur in the Pseudoscorpions, Araneina, Phalangids and Limulus, as well as in the doubtfully Arachnidan Pycnogonids.

Sub-Class I—Gigantostraca seu Merostomata.

Six pairs of cephalothoracic limbs around the mouth, the bases of the posterior pairs being masticatory. Behind the mouth a metastomial plate or pair of plates. Anterior edge of carapax acute, its upper surface bearing median ocelli and a pair of lateral compound eyes. Respiration by means of lamellate branchiæ (gill books) borne on appendages 2–6 of the abdomen and protected by the enlarged first pair (operculum) which covers them.

To these points, which cover both Xiphosures and Eurypterids, the following, derived from Limulus, may be added: No salivary glands, no Malpighian tubes, no embryonic membranes (amnion).

In this sub-class two orders are to be recognized, the Eurypterida (fossil) and the Xiphosures. In the latter are included the recent and fossil Limuloid forms. The difference between these is not readily formulated, but is readily recognized in the specimens. The affinities of Cyclus are uncertain.

Order I—Xiphosura.

Cephalothorax large, metastoma paired, telson elongate and spiniform,

Sub Order I—Limulidæ.

Abdominal somites six, coalesced.

Sub-Order II—Hemiaspida.

Abdominal somites more than six, free.

Order II—Eurypterida.

Cephalothorax small, abdomen large and elongate, twelve-jointed, the joints free, telson spatulate, metastoma unpaired.

SUB-CLASS II—ARACHNIDA.

Respiration by internal lungs or tracheæ, no compound eyes Entodermal Malpighian tubes present; Embryonic membrane (amnion) present in some.

I regard the Scorpionida as the most primitive type of Arachnida existing to-day, and the Acarina as the farthest removed from the original stem. This position of the Scorpions is shown by many facts of structure; and the pulmonate type of respiration—intermediate between the gills of the Gigantostraca and the tracheæ of the higher Arachnids—occuring in these forms is just what we should expect if the line of descent is, as here maintained, from branchiate forms. On the other hypothesis of a common origin of all "Tracheates" from some Peripatoid form, we should have the strange spectacle of the most primitive of all Arachnids with the most differentiated respiratory system.

In the Arachnida I recognize the following orders:[3]—I, Scorpionida; II, Thelyphonida; III, Araneida, IV, Solpugida;[4] V, Pseudoscorpii; VI, Phalangida; VIII, Acarina.

It is interesting to note in this connection that Pocock, on morphological grounds points out (Ann. & Mag, Nat. Hist., VI,

[3] In this I follow the order of Pocock (Ann. & Mag. N. H., Jan., 1893). His "sub-classes" Ctenophora, Lipoctena and super ordinal divisions Chaulogastra, Mycetophora and Holostomata are hardly to be regarded as of phylogenetic value.

[4] No group of Archnids will better repay study than this. I do not believe that the distinction between the "head" and the "thorax" with its three distinct somites indicates any affinities with the Hexapods, but that the conditions here existing are to be best explained upon the ground of homoplassy. The position of the anterior stigmata in the first thoracic somite is of great interest,

xi, p. 2) that "the immediate ancestor of the Arachnida was constructed somewhat as follows: The body was composed of eighteen somites, the anterior of which were provided with large appendages set apart for locomotion and the prehension and mastication of food; the terga of this cephalothoracic region were fused to form a single shield or carapace, supporting a submedian and a cluster of lateral eyes at each side, and the ventral surface of the carapace [? cephalothorax], at least in its posterior half, was protected by a sternal plate. Each of the succeeding six somites bore a pair of small ventral appendages, and the generative aperture opened upon the sternal area of the first of these somites. The posterior six somites had lost their appendages, were probably narrower than the rest, and constituted a limbless caudal portion of the body, the last of them being furnished with a single plate, articulated above the anal aperature." This should be compared with one of the Eurypterida.

Sub-Phylum II—Insecta sive Antennata.

Arthropods with differentiated head consisting of procephalic lobes and four (five[5]) somites; head with somites anchylosed and provided with four pairs of appendages modified for sensation or for feeding; respiration by means of tracheæ (modified glands) opening to the exterior on the sides of the body in the post-cephalic region. Nephridia absent, except as genital ducts, which open near the posterior extremity of the body. Ectodermal Malpighian tubes present. Spermatozoa motile.

So far as I am aware, the dissolution of the old group Myriapoda and the union of the Chilopoda with the Hexapoda was first proposed by Pocock ('87). At about the same time, I taught the same view to my classes, and later ('88) published the same. Subsequently both Pocock ('93) and I ('93, p. 248 ff.) repeated our views within a month of each other.[6] This step, it seems to me, is fully justified. The affinities of the Chilopods to the Hexapods are most close, while those of Chilopoda and

[5] See p. 125.

[6] One of our best students of the Myriapoda, the late C. H. Bollman, accepted my views and they appear in the posthumous collection of his papers ('93).

Chilognatha are quite obscure. There has been no greater stumbling-block for morphologists than the attempt to homologise the somites of millipeds and centipedes. Attempts to bring other organs into harmony are equally futile. The three groups under discussion may be contrasted as follows, it being of course admitted that we know next to nothing of the somites and serial homologies of either Diplopod or Chilopod, and that possibly future research will modify some of the statements below.

The Diplopod head bears, besides the antennæ, but two pairs of appendages—a pair of mandibles and a lower lip, composed of a pair of coalesced maxillæ.[7] In the Chilopod the conditions are as in the Hexapod, two pairs of maxillæ being present.

In the Chilopods, as in the Hexapods, each somite bears a single pair of appendages, while in the Diplopods the majority of the segments bear two pairs of appendages, and the researches of Heathcote ('88) show that each segment is, in reality, composed of two coalesced somites, a condition without parallel elsewhere in the Arthropoda. In the Chilopods there is a wide sternum separating the coxæ of the ambulatory appendages; in the Diplopods the coxæ are approximate, and the sternum is exceeding narrow, or even entirely absent.

In the Chilopods the stigmata, a pair to a somite, are lateral (dorsal in Scutigera), and are placed above and outside the insertion of the limbs, exactly as in the Hexapods. The tracheæ which arise from them are branched, and the intima is thrown into a well-developed spiral thickening as in the six-footed insects. In the Diplopoda, on the other hand, the stigmata are beneath the body[8] close to the legs, while the tracheæ (ex-

[7] The attempt made to show that this lower lip is composed of the two coalesced lower jaws, or first and second maxillæ, of the Chilognaths receives no support from the embryology of Julus (Heathcote '88), where there is but a single somite when the hypothesis calls for two. Further the innervation of the sense organs of the lower lip (*cf.* vom Rath, '86, Pl. XX, Fig. 1) shows that but a single pair of appendages is concerned in the part.

[8] In former papers I have said that the spiracles might be even *in* the coxæ. I recall having seen this statement but recently rather rather extensive reading of Myriapod literature fails to reveal my authority.

cept in the Glomeridæ) are tufted and unbranched, and the thickening of the intima is poorly developed.

In the Diplopods there are well-developed foramina repugnatoria upon the sides of each somite of the body. Such structures are absent from the Chilopods (as from the Hexapods), except in a few Geophilidæ, where repugnatorial glands occur, opening by foramina in the mid-ventral line.

In the Chilopods the reproductive organs consist of paired[9] gonads situated above the alimentary canal and opening to the exterior by ducts which are at first paired, but which later unite into a common tube which leads to a single external opening situated in the penultimate segment of the body. In the Hexapods the conditions are almost exactly the same; the gonads are dorsal, the genital ducts unite (except in Ephemeridæ), and there is a single external opening, always at the posterior end of the abdomen. In both Hexapods and Chilopods the spermatozoa are motile. In the Diplopods there is a single unpaired gonad, situated beneath the alimentary canal, and the genital duct, passing forward, divides into two, each of which has its own opening at the bases of the legs of the second post cephalic segment. The spermatozoa are quiescent.

We know so little of the embryology of the Myriapods that the aid of development can be had to only a slight extent in our comparisons,but the facts which it affords seem important. In the Chilopods the embryo escapes from the egg with numerous ambulatory appendages, a pair to each somite. The same is true of the typical Hexapods, all later observers agreeing that a polypod precedes a hexapod condition. The young Diplopod escapes from the egg in a Hexapod condition, and the presence of these six legs has been seized upon as a proof of the near association of these forms. An exact comparison, however, seems to show that the two are in reality very unlike as appears in the following table.[10]

[9] Single in Scolopendra.

[10] As nothing is known of the existence of a tritocerebral segment in the Diplopods, the comparison can only be made upon the basis of the appendages of the adult. If the tritocerebral segment should prove lacking in the millepeds, the contrast will prove stronger than it now is. The statement of the Diplopod appendages is based upon Heathcote ('88).

	Hexapoda (+Chilopod).		Diplopod.	
Appendage I	Antenna	Head	Antenna	Head
" II	Mandible		Mandible	
" III	Maxilla 1		Lower Lip	
" IV	Maxilla 2		Foot 1	
" V	Thoracic Foot 1	Thorax	Absent	
" VI	Thoracic Foot 2		Foot 2	
" VII	Thoracic Foot 3		Foot 3	
" VIII	Abdominal Foot 1		Absent	
" IX	Abdominal Foot 2		Absent	

Class I—Chilopoda.

Insecta with elongate depressed body, no differentiation between thorax and abdomen, all the somites being provided with appendages, those of the thorax-abdomen being locomotor in function.

Class II—Hexapoda.

Insecta with body consisting of not over 19 somites, divided into head, three-jointed thorax and abdomen. Thorax provided with three pairs of locomotor appendages, and usually with two pairs of wings; abdominal appendages usually lacking from most somites, those of the extremity being usually modified for reproduction and sensory purposes, those of the other somites, when present, being weak.

Sub-Phylum III—Diplopoda sive Chilognatha.

Elongate, homonomously segmented Arthropods; head distinct, bearing three pairs of appendages: no distinction between thorax and abdomen; this region with numerous somites, all, except the anterior, having two pairs of appendages (double somites), sternum narrow. Stigmata two to each somite, tracheæ tufted and unbranched, not anastomosing. Gonads single, beneath the alimentary canal; spermatoza quiescent; genital ducts opening between the bases of the second and third pairs of feet.

I have given above my reasons for the separation of the Diplopods from the Chilopods, and need not repeat them here. I do not discuss the relations of the Diplopoda to the other sub-phyla, nor the relative position to be accorded the group. The ventral position of the gonads is a mark of low rank, but in other respects the organization is much higher.

ARTHROPODA OF UNCERTAIN POSITION.

I—Pycnogonida sive Pantopoda.

Regarding the systematic position of these forms I cannot add anything to the remarks of Morgan ('90), who has shown that not only in adult structure but in certain features of development, notably in the formation of the entoderm by delamination, they present conditions not easily paralled outside of the Arachnida, and it is not impossible that they may belong there. The appendages are easily homologised in the two groups, and especially interesting is the fact that while most genera in the female retain a primitive condition in having the genital ducts open upon several pairs of appendages (IV–VII), in a few these openings occur only on the seventh appendage, exactly where they occur in the Scorpions.

II—Linguatulina.[11]

These forms, frequently associated with the Arachnids, possess but few points of similarity with them. Chief among these are the concentration of the nervous centres to a circum-œsophageal ring, and the peculiar arrangement of the ovarian follicles. On the other hand, neither embryos nor adult resemble any Arachnids in more than a few superficial features. The opening of the genital ducts in the female near the posterior end of the body is not Arachnid in character, nor is the absence of "liver" lobes from the mid-gut. Besides, as non-Arthropodan characters, may be mentioned the extensive cœlom and the outer circular body muscles. The species of Pentastomæ have been so modified by parasitism that it is

[11] Upon points of structure and development consult Stiles ('91) and Spencer ('92), in addition to the older literature.

difficult to say whether the lack of other structures characteristic of Arthropods is due to primitive simplicity or to degeneration.

III—Pauropoda.

The position of the Pauropoda is, as yet, very uncertain, as we are almost entirely ignorant of their internal structure. In the tendency towards a fusion of somites, in the lack of a second pair of maxillæ, and in the positions of the external paired openings of the genital ducts at the base of the second pair of ambulatory appendages and the non-motile spermatozoa they show undoubted affinities with the Diplopoda: but the peculiar triramous antennæ and especially the characters of the hexapod young, as figured by Lubbock ('67) and Ryder ('79) show important differences. The following table compares the somites of Pauropus and the Diplopod:

	Diplopod.	Pauropod.
Appendage I	Antenna	Antenna
" II	Mandible	Mandible
" III	Lower Lip	Lower Lip
" IV	Foot 1	Absent
" V	Absent	Foot 1
" VI	Foot 2	Foot 2
" VII	Foot 3	Foot 3

IV—Tardigrada.

Elongate metameric animals with four pairs of appendages, each terminating with two double hooks. Mouth and anus terminal, Malpighian tubes present, opening into the hind-gut. Nervous system consisting of a supraœsophageal brain and a chain of four ventral ganglia. No specialised circulatory or respiratory organs. No coxal glands or nephridia. Sexes separate, gonad unpaired, emptying into hind-gut.

Most frequently the Tardigrades are associated with the Arachnida, but this has doubtless been due to the possession of four pairs of functional legs in the two groups. These forms

differ from the Arachnids in the absence of all mouth parts,[12] in the proctodeal excretory tubes, the simple nervous system, smooth muscular tissue, and in the absence of nephridia, and they further differ from not only the Arachnids, but from all Arthropods in the fact that the gonads open into the hind-gut.

V—Malacopoda.[13]

The Arthropodan features of the Malacopoda, represented by the single genus Peripatus, are the tracheæ, the legs terminating in claws, the appendicular nature of the jaws, the exclusive use of a pair of nephridia for genital ducts, the reduced cœlom; the several ostia of the heart, the heart being enclosed in a pericardium; the lacunar circulation. On the other hand, the Malacopoda differ from all other Arthropoda and agree with the Annelids in the following particulars:

The presence of functional nephridia in each body segment; the presence of well-developed coxal glands; the existence of an outer circular muscular layer in the body wall; the absence of striation from all muscles except those of the mouth parts; the presence of cilia in the alimentary canal and in the nephridia; the situation of the antennæ as outgrowths from the primitively preoral region; the muscular nature of the pharynx, unlike that of any Arthropod and strikingly that of certain Chætopods. The eyes are too unlike the usual organs of any other Arthropod, but, as figured by Balfour, they closely resemble these organs in Autolytus. There is, too, an absence of a well-developed external cuticular skeleton, so that the absence of a true jointing in the appendages is noticeable. Judging from figures, the terminal claws of the legs might be compared with the setæ of the annelid parapodium.

On the whole, Peripatus cannot be placed beyond question in the Arthropodan phylum, and it is doubtful if it would have been placed there were it not for the presence of tracheæ.

[12] The internal acicular teeth can hardly be regarded as appendages.

[13] I prefer to use the term Malacopoda for this group, because it is the oldest, being given by Blanchard in 1847. Onychophora of Grube dates from 1853, Protracheata was given by Mosely in 1874. The failure of Blanchard to recognize all points of structure does not invalidate his name.

As we have already pointed out the existence of three different kinds of tracheæ which cannot be traced to a common origin, it is barely possible that those of Peripatus and the other "Tracheates" are not strictly homologous.

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ON A SMALL COLLECTION OF VERTEBRATE FOSSILS FROM THE LOUP FORK BEDS OF NORTHWESTERN NEBRASKA; WITH NOTE ON THE GEOLOGY OF THE REGION.

By J. B. Hatcher.[1]

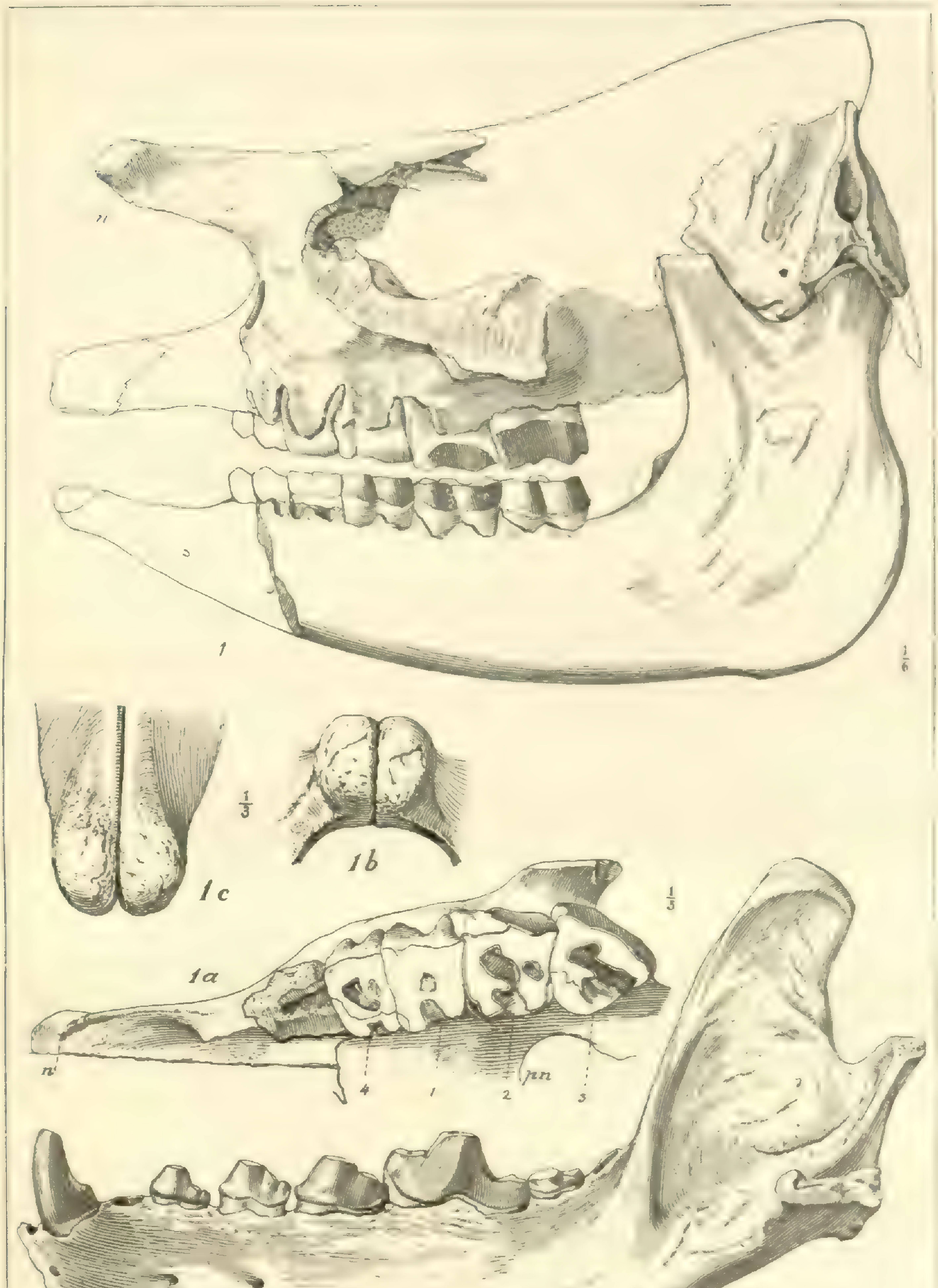
The Princeton Scientific Expedition of 1893, besides securing a quite complete series of fossils from the Protoceras beds of the upper White River, was also fortunate in securing small, but interesting collections from the Loup Fork and overlying Equus beds, and in discovering unconformities between the latter. These unconformities made it possible to distinguish sharply between the top of the Loup Fork and the base of the Equus beds; and consequently to separate the fossils of the one from those of the other with certainty.

The work in the Loup Fork and Equus beds was done by the writer previous to the arrival of the other members of the expedition. The material collected was found in the adjacent hills on the south side of the Niobrara river, midway between the mouths of Pine and Box Butte creeks in Sheridan Co., Nebraska. The material from the Loup Fork beds has been placed in my hands for description through the kindness of Prof. W. B. Scott, under whose direction the expedition was undertaken. It contains, besides several species already fully described from these beds, the following material representing one new genus, and three new species and presenting interesting characters not before noticed in species already known.

AELURODON TAXOIDES, sp. n.

Among the Loup Fork Carnivora, the genus Aelurodon was predominant, both as to individuals and species represented. In size they were propably only equalled among the Carnivora of this epoch by the sabre-toothed cats. In the latter they doubtless found formidable enemies.

[1]Curator of Vertebrate Paleontology of Princeton College.



R. WEBER, DEL.

The type of this species consists of a very complete and well preserved left mandibular ramus. It belonged to an animal about the size of the black bear. The mandible is long and proportionately slender. Posterior depth but little greater than anterior. Masseteric fossa very deep, its anterior border ending directly below the third molar. Anterior mental foramen directly below middle of second premolar. Posterior mental foramen directly below posterior root of third premolar. Surface between anterior margin of masseteric fossa and a point below the middle of the sectorial quite concave. Inferior border nearly straight from synphysis to a point directly beneath the posterior border of the second molar, when it rises quite rapidly to the angle, much as in the badger (*Meles taxus*) thus suggesting the specific name. The angle is considerably expanded transversely for the attachment of the masseter muscle. The exterior border of this expansion is on a line with the base of the teeth. The condyle is strong. The coronoid process is quite high and proportionately somewhat slender. Its upper and anterior borders, especially the latter, are considerably expanded transversely to give greater surface for the attachment of the temporal muscle. The inner border of the ramus is a nearly plane surface, except anteriorly where it is strongly convex. The dental foramen is situated about midway between molar three and the angle, and is on a line with the alveolar border. The symphysis is small and triangular in outline, and is extended somewhat below the inferior border of the jaw. Its supero-inferior diameter is about twice that of the antero-posterior diameter.

The Teeth: The incisors are missing, but they are represented by three somewhat shallow alveoli crowded closely together. The internal and middle incisors were about equal in size and quite small. The latter was crowded considerably backward out of line with the external and internal. The external incisor was considerably larger than incisors one and two. The canine is only moderately strong and is oval in cross-section at the base. The first premolar is missing, but the alveole is well preserved and shows it to have been of moderate size and fixed by one root only. There is a diastema between it and

the canine and a shorter one between it and premolar two. Premolars two, three, and four are strong, well developed teeth, they increase regularly in size and are separated by diastemata. The sectorial is large as compared with molars two and three, its antero-posterior diameter being almost double that of both these teeth taken together. The metaconid is exceedingly faint, the talon is low and flat and consists of both an external and internal cone of which the former alone has been subjected to wear. Molar two is quite small, not so large as premolar two. Molar three is missing but the alveole shows it to have been quite rudimentary and implanted by one root only in the slightly rising alveolar border of the jaw.

The present species appears to be most closely related to *A. uirsinus* Cope and *A: haydenii* Leidy. From the former it is readily distinguished by the nearly uniform depth of the jaw, by the much smaller canine and by the relative and absolute size of the premolar and tubercular teeth. In *A. ursinus* according to Cope[2] the first tubercular considerably exceeds in size the fourth premolar, in *A. taxoides* the fourth premolar is twice the size of the first tubercular. From *A. haydenii* it is at once distinguished by the much less elevated posterior portion of the alveolus, by the somewhat less massive appearance of the jaw and by the diastemata between the premolars. The following are the more important measurements of the type specimen.

	M.
Length of jaw from front of synphysis to middle of condyle	.207
Length of premolar dentition	.062
Length of molar dentition	.053
Antero-posterior diameter of sectorial	.034
Antero-posterior diameter of first tubercular	.012
Antero-posterior diameter of fourth premolar	.022
Depth of ramus below first premolar	.039
Depth of ramus below first tubercular	.040

In Plate I, figures 2 and 2[a] represent the side and crown views of the type and show well the more important charac-

[2]See U. S. Geogr. S , G. M. Wheeler, part II, Vol. IV, p. 304, 1877.

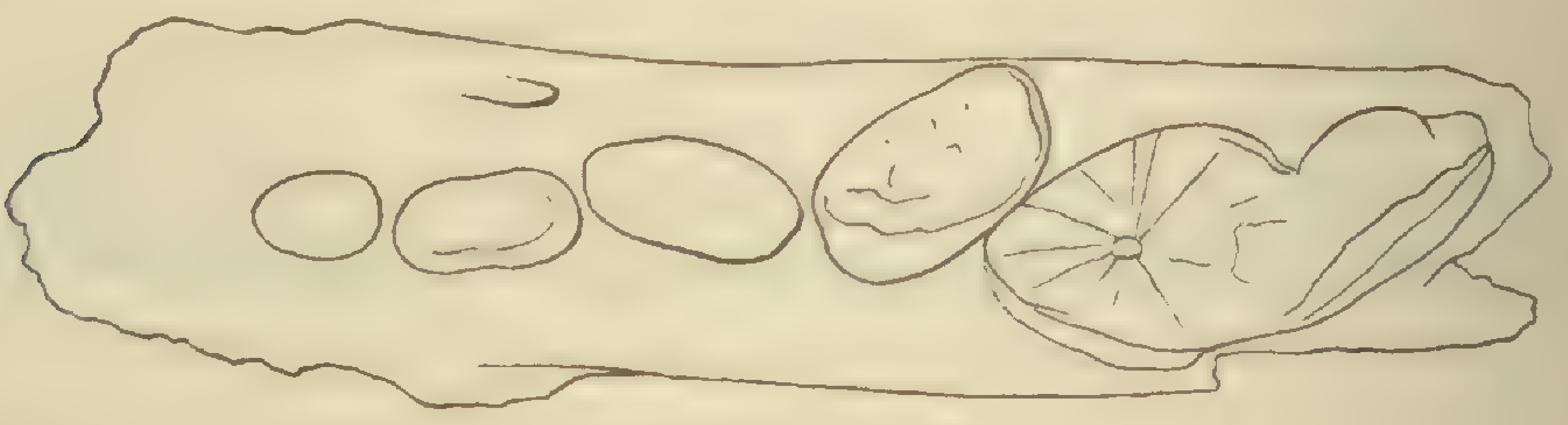
ters. An atlas vertebra found in connection with the type specimen shows a distinct foramen for the inferior branch of the first spinal nerve, but presents no other distinctive characters.

AELURODON MEANDRINUS, sp. n.

This species is by far the largest of the genus yet described. The type consists of the right mandibular ramus, broken off at the canine and just back of the sectorial. It indicates an animal about the size of the grizzly bear. The jaw was exceedingly strong and massive in proportion to its length. The crowns of premolars two and three are preserved and the roots of the sectorial and premolar four. The symphysis is quadrangular in shape and extends backward to below the middle of premolar three, its upper border approaches very closely the alveolar border. The anterior mental foramen is large and is situated just below the posterior root of premolar two. The arrangement of the teeth is especially characteristic and has suggested the specific name. The second, third, and fourth premolars are implanted in the the jaw in a zig-zag manner. The anterior end of premolar three is entirely outside of the posterior root of premolar two. Premolar four is set quite as much transversely as longitudinally in the jaw, its posterior root being as much outside of as behind the anterior. The anterior root of the sectorial is inside of and overlaps the posterior root of premolar four. This arrangement of the teeth is well shown in figs. 1 and 1^a.

The canine was very large as indicated by the alveole which is partially preserved. There was a long diastema between it and premolar one. The latter tooth was small and fixed by one root only. Premolars two and three are small and nearly equal in size. Premolar four is much larger than two and three. All the premolars are separated by very small diastemata. The sectorial is exceedingly large, its antero-posterior diameter equalling in length the space occupied by premolars two, three, and four. In fig. 1 only about half the posterior root of the sectorial is shown, thus making the tooth appear shorter than it really is. The following are the principal measurements of the type.

	M.
Length of premolar dentition	.060
Antero-posterior diameter of sectorial	.047
Length of diastema between canine and P. 1.	.019
Depth of ramus below P. 1.	.050
Depth of ramus just behind P. 4.	.055



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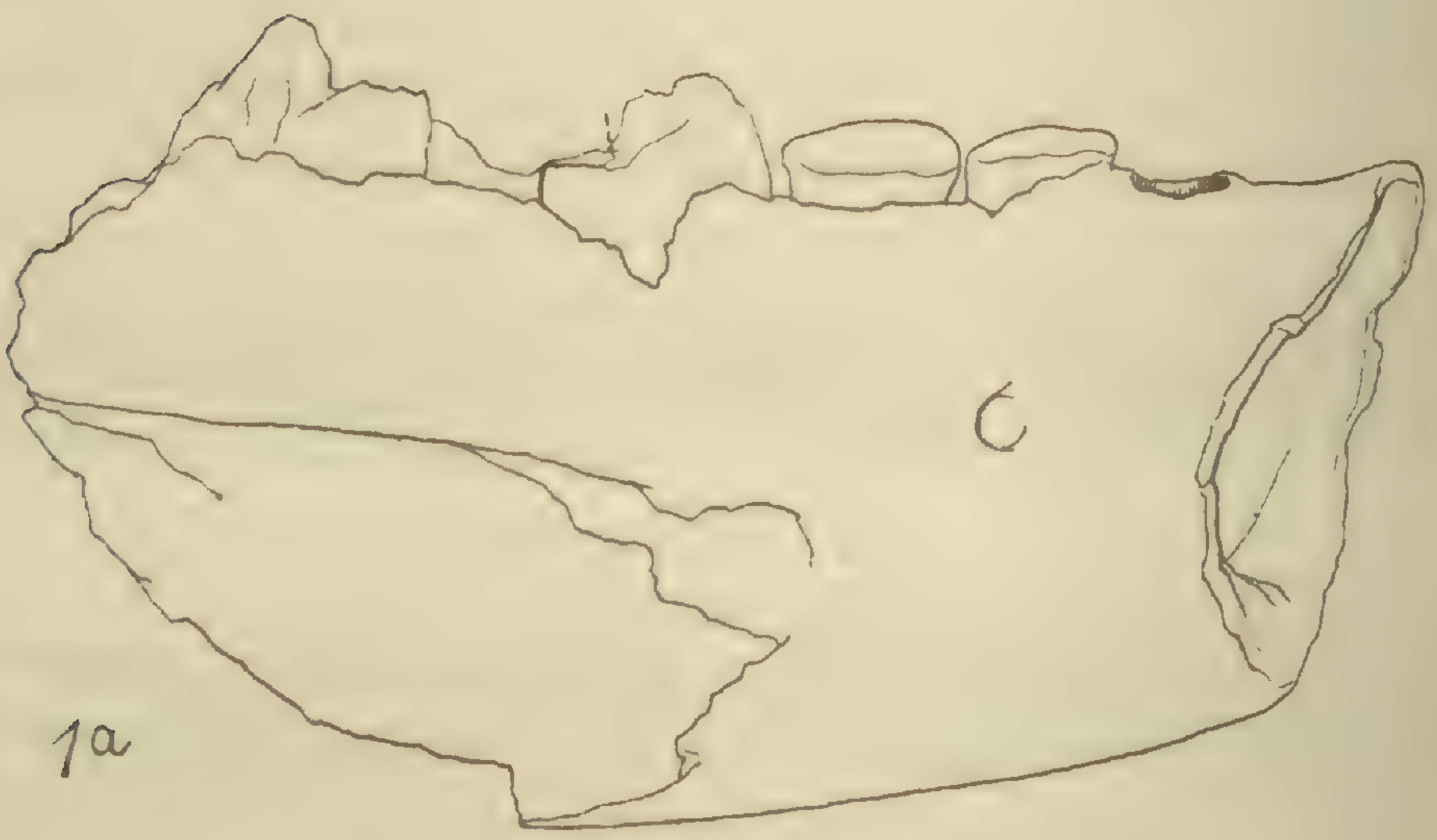

APHELOPS, Cope.

Cope has defined the genus Aphelops as follows.[3] Dentition: I ?$\frac{2-1}{1}$, C $\frac{1}{1}$, P $\frac{4-3}{3}$, M $\frac{3}{3}$; post-glenoid and post-tympanic process in contact but not coossified; digits 3–3; nasals hornless. To these characters Osborn[4] has added: "Magnum not supporting lunar anteriorly; absence of the crista and invariable presence of the more or less strongly developed 'crochet' and 'anticrochet' in the superior molars." The projection referred to by Prof. Osborn as the anticrochet is, I think, really the crista, since it is produced quite as much or more from the

[3]Bull. V, U. S. G. S., 1879–80.

[4]Bull. Mus. Comp. Zool. Harvard, p. 92.

upper border as from the lateral, and moreover, an examination of material in our collection shows in molar one of Aphelops and molor two of Teleoceras an additional small projection directly opposite the large anticrochet, and which I believe to be the crochet and have so lettered it. See Plate II, figs. 5 & 6. I would therefore amend Prof. Osborn's dental characters to read as follows: Invariable presence of strong anticrochet and crista and absence of well defined crochet on superior molars. If this projection is not the crista, it is the crochet instead of the anticrochet, as considered by Osborn.

APHELOPS FOSSIGER, Cope.

I have referred a nearly complete skull in our collection to the above species. It differs from Cope's definition of that species however by the following characters which may perhaps be considered of specific importance. In molar one the the median sinus is obstructed by a large crista and anticrochet and a very small crochet, in molar two there is no trace of a crochet and at the bottom of the entrance of the median sinus there is a small tubercle. In molar three at the bottom of the entrance of the median sinus, there is an elongated tubercle placed transversely, and just inside this is a second much smaller conical tubercle. At about the middle and on the upper border of the zygomata there are processes curving inward and downward which probably served as attachments for the zygomatico-auricularis muscles. The molar teeth also are extremely large. Below are some of the measurements.

	M.
Length of true molars	.168
Median length of second molar	.062
Greatest length of second molar	.075
Greatest width of second molar	.077

TELEOCERAS MAJOR, Hatcher.

As stated in a preliminary notice,[5] this genus is distinguished from all previously known genera of the *Rhinocerida* by

[5] Am. Geol., March, 1894, pp. 149–150.

the presence of a median horn on the extremities of the nasals, the presence of a sagittal crest? as indicated by the contour of the outer walls below this region and the presence of a strong anticrochet and crista and the absence of a well developed crochet on the superior true molars.

The type consists of a portion of the skull and lower jaw. The superior and inferior molars are preserved and also the fourth upper premolar. The skull is long and proportionately much deeper and narrower than in the closely allied genus Aphelops. The nasals are only partially coossified, they are very thick and strong, much compressed anteriorly and strongly convex superiorly. Their extremities are prolonged into a short, stout horn which extends about an inch beyond the extremities of the nasals proper, and is directed upward and forward, it is slightly constricted inferiorly just in front of the termination of the nasals; it is rugose and in life evidently supported a dermal horn. These characters are well shown in Plate I, figs. 1, 1^b, 1^c, 1^d. The frontals are comparatively narrow and smooth, and their upper transverse surface is gently convex, they are elevated posteriorly so that the median line from the posterior portion of the frontals to the end of the nasal horn is slightly concave. The infra-orbital foramen is large, opens anteriorly and not laterally directly over the middle of premolar three. The maxillaries are large, strong and deep. The anterior border of the posterior nares is on a line with the posterior border of the median sinus of molar two, there is no median projection. The temporal region is much constricted, the inferior lateral walls of the brain case in this region are exceedingly thin, there were no air cavities in this region of the skull. The base of the skull sloped upward and forward from the condyles which are missing. The post-glenoid process is strong and triangular in cross-section, it is confluent *but not coossified* with the post-tympanic throughout the greater portion of their length, thus entirely enclosing the *meatus auditorius externus.*

The lower jaw is exceedingly strong and massive. The ascending portion is very high and broad with the posterior border but slightly expanded transversely. The masseteric

fossa is very shallow. The inferior dental foramen is large. The coronoid process is wide at the base and narrows rapidly toward the apex. The angle is produced but slightly downward. The inferior border is gently convex.

The Teeth: Of the superior dentition the true molars and the fourth upper premolar alone are represented. They are larger than in the recent rhinoceros but much smaller than in *Aphelops* as shown in Plate II, figs. 5, 6, & 9. Molars two and three are best preserved and present the most distinctive characters. The dorsum is very flat, there is no median costa and the anterior and posterior costae are only faintly represented On the posterior angle of molar three there is a well developed basal cingulum. The median sinus of this tooth is obstructed by a well developed anticrochet and crista. At the bottom and near the entrance of the median sinus is a small tubercle. Molar two has a faint crochet directly opposite the strong anticrochet and a well developed crista as shown in Plate II, fig. 6. There was a deep posterior sinus with a strong posterior vallum which in the type has been worn down so that the posterior sinus now appears as a posterior fossette. There is a very small anterior sinus and the anterior vallum is weak. In molar one and premolar four the teeth are so much worn that the anterior and posterior cross-crests are united through the anticrochet, and the inner portion of the median sinus appears as an accessory fossette.

In the inferior dentition the last molar is placed well in front of the ascending portion of the ramus, it is but little larger than molars one and two, and has a basal cingulum on the posterior border. The following are the principal measurements of the skull, lower jaw, and teeth.

SKULL AND SUPERIOR DENTITION.

	M.
Length of skull from end of nasal horn to behind post-tympanic process	.585
Depth of skull from middle of frontals to crown of teeth	.235
Width of skull in front of zygoma	.210

Length of horn beyond termination of nasals	.028
Diameter of horn	.041
Length of molar dentition	.158
Greatest transverse diameter of molar two	.069
Greatest antero-posterior diameter of molar two	.055

LOWER JAW AND TEETH.

	M.
Length of ramus from anterior border of premolar four to posterior border	.420
Height from bottom of angle to condyle	.260
Depth below molar three	.109
Length of molar dentition	.155
Length of molar two	.054
Length of molar three	.058

Teleoceras although presenting several characters apparently intermediate between Aphelops and existing genera of Rhinoceridæ, nevertheless cannot be considered as an ancestor of the latter. Neither is it a migrant from Europe. It is really a horned Aphelops derived perhaps through Leidy's species *A. crassus;* which latter is not unlikely to be identical with *A. fossiger* (Cope) and *A. acutum* (Marsh), all of which have been described as possessing compressed, acuminate nasals, thus suggesting a horn at the very place where it appears in *Teleoceras.*

The discovery of a *median horned Rhinoceras* in America is of interest not as a probable ancestor of existing Old World forms, but rather as exhibiting a remarkable example of *parallelism* in the development of the Old and New World species of Rhinoceridæ from their common ancestral genus Aceratherium of the lower Miocene of this continent. Our present knowledge would indicate, as has been pointed out by Scott,[6] that the ancestral type originated in America and found its way into the Old World in early Miocene times. The genus Aceratherium which flourished during the lower Miocene was common to both continents, and all the median horned

[6]See Bull. 3, E. M. Museum, Princ. Coll., pp. 1–22, 1883.

and hornless forms of each continent may reasonably be considered to have been developed independently from it. There seems at present no evidence for supposing that there was any interchange of species between the two continents later than early Miocene times. This degree of parallelism is all the more striking when we consider the length of the period of isolation in connection with the marked degree of similarity shown. This similarity is exhibited not only in the development of a nasal horn, but also in the general appearance of the skull, the complexity of the structure of the teeth and their arrangement in the jaw, and the relations of the post-tympanic and post-glenoid processes, Figs. I–4, Plate II, show the latter in the genera Rhinoceros, Teleoceras, Aphelops and Ceratorhinus. On the same plate, figs. 5, 6, 7, 8 & 9 represent various stages of tooth development from Aceratherium to Teleoceras and recent forms. As regards specialization of parts and complexity of tooth structure, from what is at present known of Teleoceras, it may be regarded as equalling in these respects any of our recent forms. If we compare it with *Rhinoceros sansaniensis* (Lartet) from a horizon in France of which our Loup Fork has been considered an equivalent, it will at once be seen that the tooth structure of the latter is much simpler and more like Aceratherium. See Plate II, fig. 7 (after Filhol). If these beds be really of the same age we must conclude that the conditions favorable for the development of the more modern types of the Rhinoceridæ, existed to a much greater degree in America than in Europe, a condition of affairs not improbable when we reflect that the family was originated on this continent.

Technically, perhaps, Teleoceras should not be considered as generically distinguishable from Rhinoceros, and had it been found in Europe it would doubtless have been referred to that genus. Since however it is an American form, found in the same beds with Aphelops, its unmistakable ancestor, which latter as has been shown by Cope, Scott and Osborn, is quite distinct from Rhinoceros, I have decided to refer it to a distinct genus; believing that classification should rest so far as possible upon our knowledge of actual relations, and should

be an expression of those relations so far as they are understood and not a mere set of conveniences, based entirely upon the presence or absence, and similarity or dissimilarity of parts.

GEOLOGY OF THE REGION.

In the immediate region in which the collections were made, only two distinct geological horizons appear on the surface, these are the Loup Fork and Equus beds. None of the water courses have here succeeded in entirely removing the Loup Fork, and exposing the underlying older strata. The Loup Fork beds consists of light colored, calcareous sandstones, somewhat loosely cemented, resembling in color and friability, old mortar. They are everywhere penetrated by numerous calcareous rods or tubes, probably the casts of root-stocks of aquatic plants. They dip very gently to the southeast which is evidenced by the fact that the southern slopes are gentle, while those looking northward are abrupt. Where they have not been entirely removed by erosion, the Equus beds unconformably overlie the Loup Fork beds. This unconformity has been overlooked by all previous explorations in this region. Marsh makes no mention of it in reporting on his expedition into this very place in 1872; and in his subsequent descriptions of vertebrate fossils from these beds, he has not distinguished between them, although their respective faunas are really quite distinct, and the beds themselves are not the result of a continuous sedimentation from the commencement of the one to the close of the other; but there was an important break at the close of the Loup Fork when this region became dry land, and remained such through a long period of time, after which the Equus beds were deposited upon the eroded surface of the Loup Fork.

The Equus beds are composed of loose, incoherent sands, except for occasional layers of somewhat tough, gritty clays. The rapidity with which they yield to erosion, and their generally incoherent nature has greatly aided in concealing their exact statigraphic relations to the underlying beds. In

almost all exposures the exact contact is concealed by a *talus* from the upper beds. In several instances, however, the true relations were easily determined and one, which presented particularly favorable conditions is represented here in fig. 2. It represents a short section of the east side of one of the main 'draws' emptying into the Niobrara river. At this point this small water course has cut directly across the bed of a similar water course eroded out of the surface of the Loup Fork and since filled by the Equus beds. At this same point there enters the main 'draw' a small tributary from the east, and the combined currents of these two water courses, although

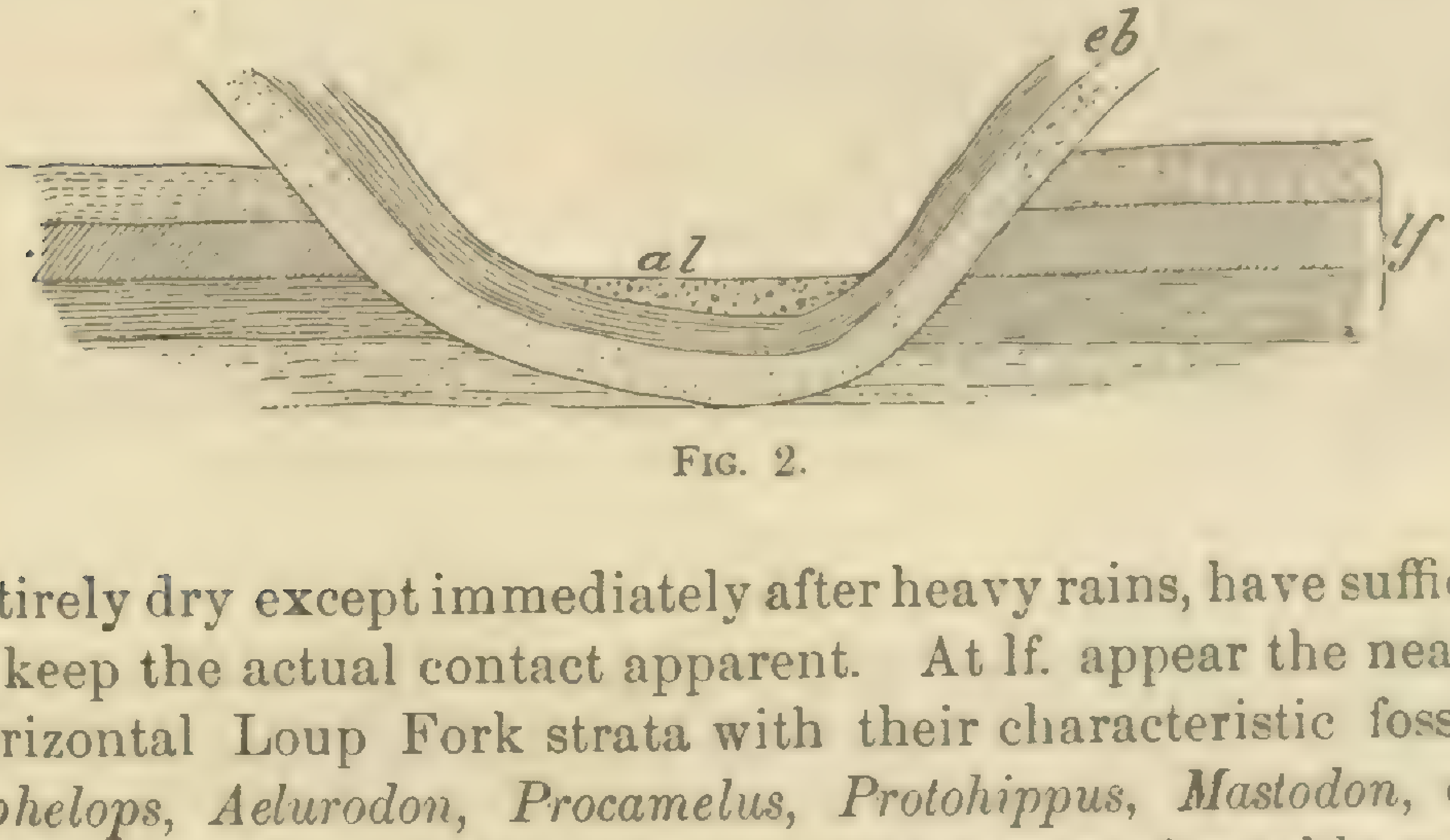

FIG. 2.

entirely dry except immediately after heavy rains, have sufficed to keep the actual contact apparent. At lf. appear the nearly horizontal Loup Fork strata with their characteristic fossils, *Aphelops, Aelurodon, Procamelus, Protohippus, Mastodon,* etc. At eb. the Equus beds are seen resting unconformably upon the Loup Fork beds at an angle of about 15° and containing fossils characteristic of these beds, *Equus, Elephas, Mylodon, Canis,* etc.; al. represents the recent deposits in the bottom of the "draws," all below the top of this line is imaginary. On the opposite side of the main draw the same conditions are seen at the bottom, but toward the top the contact is not so apparent, since there is on this side no tributary to aid in keeping the exposure free from talus.

The figures in the plates and the text accompanying this paper were executed by Mr. Rudolph Weber. To the various members of the expedition, whose liberality made it possible, the authors best thanks are especially due.

Explanation of Plates.

Plate I.

Fig. 1. Side view of *Teleoceras major*, n. end of nasals.

1^a. Bottom view of *Telèoceras major*, n. end of nasals, pn. posterior nares.

1 . Front view of nasal horn of same.

1^c. Top view of nasal horn of same.

Fig. 2. Side view of lower jaw of *Aelurodon taxoides*, amf. anterior mental foramen, pmf. posterior mental formen.

2^a. Crown view of same; pa^d, paraconid, pr^d. protoconid, hy^d. hypoconid, me^d. metaconid, en^d. entoconid.

Plate II.

Fig. 1. Side view of temporal region of *Rhinoceros sondaicus* (after Flower), mae. meatus auditorius externus, pg. post-glenoid process, pt. post-tympanic process.

Fig. 2. Side view of temporal region of *Teleoceras major*.

Fig. 3. Side view of temporal region of *Aphelops fossiger*.

Fig. 4. Side view of temporal region of *Ceratorhinus sumatrensis*.

Fig. 5, Second, left upper molar of *Aphelops fossiger?* crs. crista, acr. anticrochet, ps. posterior sinus.

Fig. 6. Second, left upper molar of *Teleoceras major*, crs. crista, acr. anticrochet, cr. crochet, ms. median sinus, as. anterior sinus, pf. posterior fossette.

Fig. 7. Second, left upper molar of *Rhinoceras sansaniensis* (after Filhol), ps. posterior sinus, pv. posterior vallum.

Fig. 8. Second, left upper molar of *Aceratherium occidentale?* letters as in fig. 6.

Fig. 9. Second, left upper molar of *Ceratorhinus sumatrensis*, cr. crochet, pv. posterior vallum.

EDITORIALS.

—The postoffice department at Washington adopted last year a new style of letter box for cities, which has generally replaced the old ones. This change has been for the worse in one important respect. While the boxes of the new pattern afford better protection from thieves, they are unfit for the reception of second and third class matter generally. The opening is too small, and the fore and aft diameter is too narrow to receive the greater part of such matter. In the attempt to use these boxes for such matter, it is apt to be injured, but usually it cannot be inserted. As the new boxes were not, we learn, intended to exclude such matter, they show a lack of intelligence on the part of both the designer and the department. The old boxes are much more useful, but a new box of the modern pattern, with a wider gape and deeper throat, would be better still. Editors and publishers would be much accommodated by such a change. This would be an improvement much more important than most of the novelties introduced by the last administration of the postoffice department.

—The International Congress of Zoologists of 1892, was held at Moscow, and was an occasion of much interest. Many important papers were read, a majority of them naturally having reference to various parts of the vast territory under the dominion of the Czar. A peculiar feature of the volume issued by the Congress, which embraces the papers read or abstracts of them, is that it contains a full page portrait of the Grand Duke Serge Alexandrowitch in military costume, as a frontispiece. Below the portrait is a fulsome expression of "veneration and thanks" for aid rendered the Congress by "his imperial highness." This strikes us as strangely out of place in a zoölogical work, and not less so because the Congress was "international." The singing of the Russian national hymn, with which the last session of the Congress was closed, can hardly be regarded as an "international" zoölogical ceremony.

—The conduct of the authorities of the Chicago Exposition since its close, has not been characterized by that care for the property of the exhibitors and others necessarily under their charge, which should characterize an honorable corporation. The buildings have been left insufficiently guarded, and tramps have had full opportunity to perpetrate mischief. Among these, incendiary fires have been conspicuous,

so that damage has been done to the property of exhibitors, and many narrow escapes have been made. The dismantelment of the fire apparatus has rendered the situation all the more dangerous. Finally the quarters for the shelter of the strangers engaged in moving their exhibits have been rendered uninhabitable at an inclement season of the year. Altogether, the hospitality of Chicago to exhibitors and national commissions has been scanty, and this part of the exposition management does not redound to the credit of the city. It is in marked contrast to that which has characterized the expositions held elsewhere in both Europe and America.

—The closing of the Allis Biological Laboratory at Milwaukee, is much to be regretted, but as it is due to the financial stringency, it is to be hoped that, with the return of more prosperous times, it will be reopened by its public-spirited and scientific founder.

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WOODWARD, M. F.—On the Development of the Teeth of the Macropodidae. Extr. Proceeds. Zool. Soc. London, 1893. From the author.

RECENT LITERATURE.

The Canadian Ice Age.[1]—This volume, an octavo of 300 pages, is a compilation of observations bearing upon the history of the northern half of the North American Continent during the Ice Age, recorded by Sir Wm. Dawson since 1855. The generalizations are not extended beyond the Canadian border, but the author's conclusions deny the possibility of large accumulations of land ice on an interior continental plain, south as well as north of the Canadian boundary. In fact, at that time, according to the author, there was no interior plain. An ideal map of Canada during the Plistocene Age, shows the northern half of the continent to consist of three large mountainous islands, the Cordilleran, the Laurentide, and the Appalachian, with Greenland to the north, surrounded by ice ladened seas and straights. These islands were the gathering-grounds of the snow and ice that, in the form of glaciers and icebergs, were such powerful agents in modifying the topography of the continent. The ice movement on these islands appeared to be outward in all directions from a central axis or plateau, analagous to what is taking place in Greenland at the present day. The "Terminal Moraine" of the glacialists represents the shore line of the ice-ladened sea where floe-ice and bergs grounded with their burden of boulders and other débris. Anomalies in the levels of the so-called terminal moraine are due to differential elevation. The author gives a résumé of the the present knowledge of the glacial movements during the Plistocene period, as shown by the striae, and the conditions under which the Boulder-drift of Canada was deposited as proofs of the above theory.

The succession of deposits is treated of at length, and the subject is summarized in tables of succession and correlation. In an ascending order the strata are (1) a lower boulder clay or till resting on heavily striated rock surface, representing shallow water deposit; (2) Leda clay, the greater part of which, from the evidence of its fossil contents, was laid down in water from 20 to 100 fathoms deep; (3) surface boulders.

In regard to the striae, the author makes the following general statement as to the agents producing them:

[1] The Canadian Ice Age. Being Notes on the Plistocene Geology of Canada, with especial reference to the Life of the Period and its Climatal Conditions, and lists of the specimens in the Museum. By Sir J. Wm. Dawson. Montreal, 1893.

"In summing up this subject, it may be affirmed that when the striation and transfer of materials have obviously been from N. E. to S. W., in the direction of the Arctic current, and more especially when marine remains occur in the drift, we may infer that floating ice and marine currents have been the efficient agents. Where the striation has a local character, depending upon existing mountains and valleys, we may infer the action of land ice. For many minor effects of striation, and of heaping up of moraine-like ridges, we may refer to the presence of lake or coast ice as the land was rising or subsiding."

Again, "Sea glaciation is always accompanied with much smoothing and polishing, and on very hard rocks the striation is comparatively imperfect, while it is not quite uniform in direction and often presents two sets of striae. The action of true land glaciers, especially when moving down considerable slopes, produces deep grooves, as well as striae, on vertical as well as on horizontal surfaces, and is more fixed and uniform."

The summary of fossils given in Chapter VI, comprises 240 species, of which 33 are plants; the rest are distributed as follows: Protozoa, 21; Echinodermata, 7; Mollusca, 142; Vermes and Arthropoda, 30; Vertebrata, 7. From both flora and fauna the author infers an amelioration of the climate, resulting, in his estimation, from the gradual elevation of the land which threw the Arctic currents from its surface, exposed a larger area to the direct action of solar heat, and probably determined the flow of marine currents so that the heavy northern ice was led out into the Atlantic instead of being drifted southwest over the lower levels of the continent.

The leading thoughts in this collection of papers is the relative value of land ice and water-borne ice as causes of geological change during the Plistocene period. These two agents, together with the complex elevations and depressions of the continent as shown by the deposits and their fossil contents account for the effects observed.

This paper is an important one, and will probably correct the extravagancies into which the past glacialists have faller.

The Mollusc-Fauna of the Galapagos Islands.[2]—The molluscan forms collected by Professor Leslie A. Lee and his assistants, on the voyage of the U. S. Fish Commission Steamer Albatross, from

[2] Scientific Results of Explorations by the U. S. Fish Commission Steamer Albatross. No. XXV. Report on the Mollusk-fauna of the Galapagos Islands, with Descriptions of New Species. By Robert E. C. Stearns, Ph. D. Adjunct Curator of the Department of Mollusks. Proc. U. S. Nat. Mus., Vol. XVI, (1893) pp. 353-450, with plate and map.

Chesapeake Bay by the way of the Strait of Magellan to San Francisco in 1887–88, is the basis of this paper which is, as will be seen in the foot-note, a report on the Galapagos material belonging to this division of the animal kingdom. As the author states in the text, it "refers, so far as the marine molluscs are concerned, with a few exceptions, to the littoral and shallow-water species only." The deep sea material remains to be investigated and reported on hereafter, though a few species described by Dall are included in the list, in the later part of the report.

The geographical and physical characteristics of the islands, their climatology and floral aspect, the distances and depths of the water between them, their origin, and the views of Darwin, Hooker, Wallace, Agassiz, Baur, etc., hereon are briefly presented. The origin of the fauna and the flora is discussed, and in this connection the distribution of terrestrial and marine forms, etc., by oceanic currents, drift lodgement, freshets, and the agency of rivers, and the aerial distribution of animal and plant life, as well as the generative capacity and vitality of land snails, their ability to exist a long time without food, of which numerous instances are given, and the tenacity of life in many species that have been observed, are all referred to and treated at considerable length.

The author favors the *volcanic theory* of the region of these islands as held by the majority of scientific writers, rather than that of Dr. Baur and Milne-Edwards, who regard the Galapagos as "*Continental Islands originated through subsidence*," a conclusion based principally on biological evidence, etc.. as exhibited in their peculiar fauna and flora.

The number of molluscan species and varieties obtained by the Albatross collectors was 120, of, these 7 species and 9 varieties were terrestrial forms. Four new species are described, and one of these is a land shell, *Bulimulus* (*Pleuropyrgus*) *habelii*; the others are *Onchidium lesliei*, *Nitidella incerta*, and *Tectarius galapagoensis*.

As a part of the report, the late Dr. Philip Carpenter's list of the Galapagos species contained in Reeve's Monograph's is given, also Albers' list of Galapagos *Bulimi*; the Petrel-Cookson shells, as determined by E. A. Smith of the British Museum; Wimmer's list of Habel's collection; Ancey's species, and Reibisch's list of species collected by Dr. Theodor Wolf, State Geologist of Ecuador; Dr. W. H. Jones' Chatham Island shells, Dall's recently described Galapagos species, including a few deep water forms, a part of the Albatross dredgings, and a few land species collected by Dr. Baur.

Following the above the author has added a systematic list, summarized from the preceeding authorities. This compilation, which will be found very convenient by the student, shows a total of 318 species and varieties; of these 48 species and varieties are terrestrial and the others marine. Of the latter, 61 are Lambellibranchs and 1 Scaphopod; 205 species and 13 varieties are Gastropods.

Of the marine species the author says, "Less than a half score are indigenous, of these, some, if not all, may prove, upon a better knowledge of the molluscs of the shores of Central and South America, to belong to the mainland." A comparison is suggested of *Omphalius cooksonii* Smith, with the Antillean *O. fasciatus*. The number of species that exhibit intimate relationship with Antillean-Carribean forms is quite small and in conspicuous when placed side by side with the American types; the latter include nearly all the species contained in the summarized list.

The author observes that the land shells are of a distinctly West South American aspect, and a comparison is suggested with several species named, which occur in Bolivia, Peru and Chili, rather than to the peculiar forms inhabiting Ecuador and other South and Central American States further north.

In several instances the erroneous determination of marine species or varieties of the same, that have been made by various authors resulting in the accrediting of Indo-Pacific forms to the Galapagos Islands, have been pointed out and explained. The report closes with a plate containing figures of the species described, and the map of the Galapagos islands.—CHAS. T. SIMPSON.

An Examination of Weismannism.[3]—The several chapters comprised in this volume have been written at successive intervals during the last six or eight years, as Professor Weismann's works have appeared, so that this discussion by Mr. Romanes presents a clear view of the growth of the Weismannian theories. Three chapters are devoted respectively to Weismann's system up to the year 1886—to the year 1892—to the year 1893. Of the two remaining chapters, one is a discussion of Weismann's theory of heredity (1891), the other is a critical examination of Weismann's theory of evolution (1891). Two appendices entitled "On Germ Plasm and On Telegony" complete the volume.

In conclusion, the author refers to the fundamental changes which Professor Weismann has wrought in his general system of theories by

[3] An Examination of Weismannism. By George John Romanes, M. A., LL.D., F. R. S. Chicago, 1893. Open Court Publishing Co.

the publication of his more recent works, and closes with the following remarks:

"Thus, the Weismannian theory of evolution has entirely fallen to pieces with the removal of its fundamental postulate—the absolute stability of germ-plasm. It only remains to mention once more the effects of this removal upon the other side of his system, viz., the companion postulate of the uninterrupted continuity of germ-plasm, with its superstructure in his theory of heredity."

Briefly, these effects are as follows:

"1. Germ-plasm ceases to be continuous in the sense of having borne a perpetual record of congenital variations from the first origin of sexual propagation.

"2. On the contrary, as all such variations have been originated by the direct action of external conditions, the continuity of germ-plasm in this sense has been interrupted at the commencement of every inherited change during the phylogeny of all plants and animals, unicellular as well as multicellular."

"3. But germ-plasm remains continuous in the restricted, though still highly important sense, of being the sole repository of hereditary characters of each successive generation, so that acquired characters can never have been transmitted to progeny "representatively," even although they have frequently caused those "specialized" changes in the structure of germ-plasm which, as we have seen, must certainly have been of considerable importance in the history of organic evolution."

"4. By surrendering his doctrine of the *absolute* stability of germ-plasm on the one hand, and of its *perpetual* continuity on the other, Weismann has greatly improved his theory of heredity. For, whatever may be thought of his recent additions to this theory in the way of elaborate speculation touching the ultimate mechanism of heredity, it is a great gain to have freed his fundamental postulate of the continuity of germ-plasm from the two further postulates which have just been mentioned, and the sole purpose of which was to provide a basis for his untenable theory of evolution."

"5. In my opinion, it only remains for him to withdraw the last remnant of his theory of evolution by cancelling his modified and even less tenable views on amphimixis, in order to give us a theory of heredity which is at once logically intact and biologically probable."

"6. The theory of germ-plasm would then resemble that of stirp in all points of fundamental importance, save that while the latter leaves open the question as to whether acquired characters are ever inherited in any degree, the former would dogmatically close it, chiefly on the

grounds which I have considered in Appendix II. It seems to me that in the present state of our knowledge, it is more prudent to follow Galton in suspending our judgment with regard to this question, until time shall have been allowed for answering it by the inductive methods of observation and experiment."

"7. Hence, in conclusion, we have for the present, only to repeat what Weismann himself has said in one of the wisest of his utterances: 'The question as to the inheritance of acquired characters remains, whether the theory of germ-plasm be accepted or rejected.'"

"It is now close upon twenty years that I have accepted the substance of this theory under the name of stirp; and since that time the question as to the inheritance of acquired characters remains exactly where it was. No new facts, and no new considerations of much importance, have been forthcoming to assist us in answering it. Therefore, as already stated in the preface, I intend to deal with this question hereafter as a question of *per se*, or one which is not specially associated with the labors of Professor Weismann."

The theory entitled by Romanes by the name of "stirp," was tentatively suggested by Galton in 1875, and was more distinctly enunciated in the AMERICAN NATURALIST for 1889, under the head of Diplogenesis. An acceptance of it is to be found in the article by vom Rath which is republished in the January NATURALIST. It is evident that the diversity in the views of biologists as to the inheritance of acquired characters is becoming more verbal than real.

Extinct Monsters.[4]—In this book of some 250 pages Mr. Hutchinson has endeavored to give a popular account of some of the larger forms of extinct animals, and has illustrated the several chapters with drawings of restorations of them. These drawings are commended to the public by Dr. Henry Woodward, who pronounces them, in a preface, "the happiest set of restorations that has yet appeared."

The author devotes seven of the sixteen chapters to the Saurians, drawing upon the discoveries in the United States for much of his material. Under the head of Sea-Scorpions many points of interest concerning Pterygotus and its allies are given. American Mammals are represented by one species from the Eocene, one from the Neocene, and one from the Plistocene. From the varied Sivalik fauna of India, the author chooses Sivatherium and *Testudo atlas*, and from South America the characteristic Sloths and Glyptodons. The remaining

[4] Extinct Monsters. A Popular Account of Some of the Larger Forms of Ancient Animal Life. By Rev. H. N. Hutchinson, with illustrations by J. Smit. London, 1893, Chapman and Hall, Publishers.

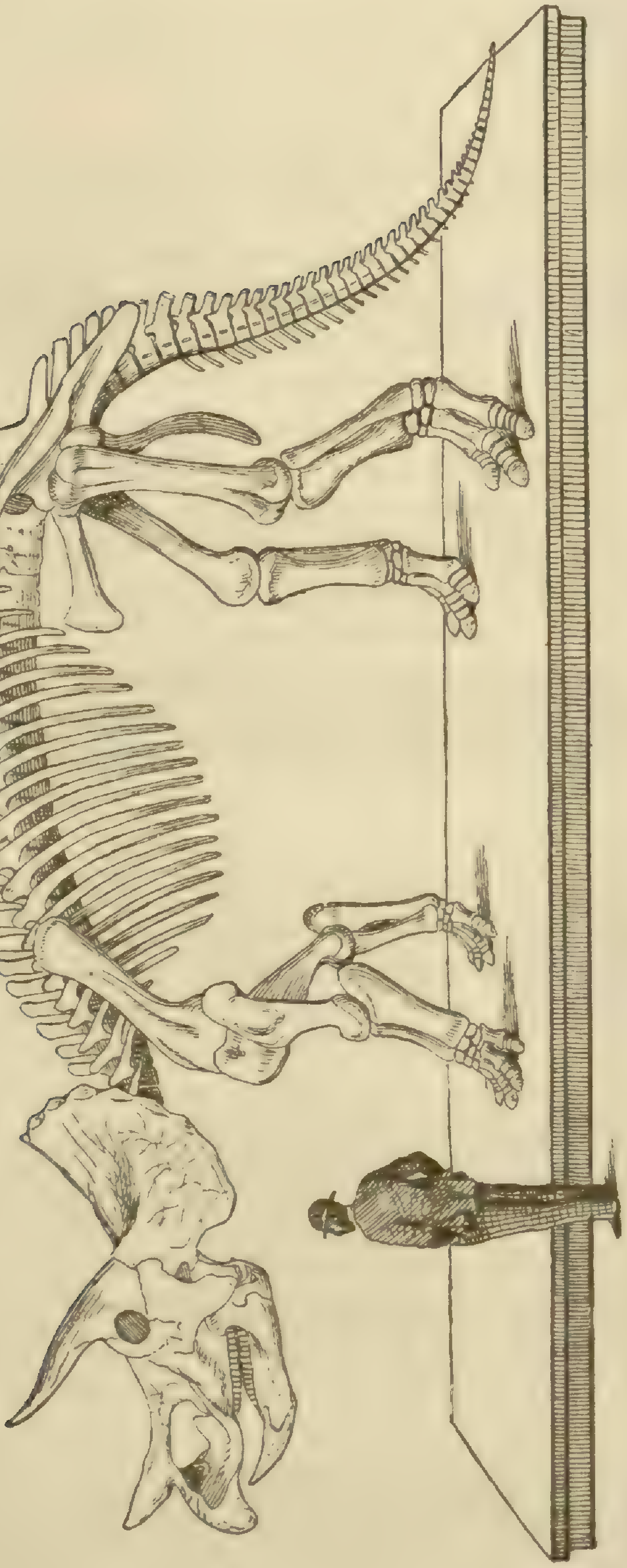

FIG. 1. *Agathaumas flabellatus.* Skeleton. From Marsh.

From the Laramie of N. America.

Fig. 2. Camarasauru-, from the Juarssic of North America.

chapters describe the Mammoth, the Mastodon and the Wooly Rhinoceros, Some Giant Birds, the Irish Elk and Steller's Sea-Cow.

In the appendices reference is made to the recent discoveries by Dr. Fraas of the structure of the dorsal and tail fins of *Ichthyosaurus tenuirostris*, and to Mr. Henry Lee's discussion as to the existence of the great Sea-Serpent. Here also is given a list of British localities where mammoth remains have been found.

The book is written in an entertaining style, and it is likely to interest the lay reader in the subject. That it will have considerable effect in extending a knowledge of the extinct forms of animal life there can be no doubt. Meanwhile it is a pity that the author did not consult some one familiar with the subject, who could have given him the correct nomenclature of some of the forms which he portrays. Thus the so-called Stegosaurus was previously named Hypsirhophus; and paleontologists who have seen both, allege that the name Brontosaurus was given to the reptile previously named Camarasaurus. It is probable that Triceratops is Agathaumas, which was named and described fourteen years before the former name was given. It would have been better to have given a restoration of the *Loxolophodon mirabile* Marsh, rather than one of the *L. ingens;* since a skeleton of the former is known, while none of the latter had been obtained at the time the so-called restoration was made. We understand that a second volume is in preparation, which will contain other forms not included in the one under review. There is a fine field yet open in this direction, and we hope that Mr. Hutchinson will be able to take advantage of it. We owe to the courtesy of the publishers the opportunity of presenting two of the illustrations.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Trans-Pecos Texas.—The studies of Mr. Streeruwitz in western Texas have developed some interesting facts from both a scientific aud economic standpoint. The rocks are mostly older and newer eruptives and various metamorphics; the sedimentary, as now known, reach from the Silurian to the Cretaceous period, and Cenozoic deposits are probable. The petrography of the Igneous rocks has been reported upon by Mr. A. Osann in the Ann. Rept. for 1892, Geological Survey of Texas. The results of his examinations show the great diversity of the character of the rocks prevailing in the different mountain ranges and the great difference in time and conditions of their origin.

Mr. Streeruwitz finds that the disintegration of the rocks in Trans-Pecos Texas is mostly the result of the rapid changes of temperature and deflation, the same forces active in the desert of Sahara. The rains are also the cause of another source of disintegration causing that peculiar shape of granite blocks peculiar to the Sahara called "Pilzfelsen." Chemical action manifests itself in the formation of rows of caves in the stratified granular rocks similar again to the African deserts.

The prevalence of ozone in West Texas is explained by the author as the result of the friction of the drifting sand grains among themselves and along the surface of the soil and the rocks, which creates sufficient electricity to ozonize the oxygen of the atmosphere.

In regard to the ores, Mr. Streeruwitz reports that the most of the mountain ranges of Trans-Pecos Texas are ore-bearing. These ores are of excellent quality and exist in paying quantities, along with building stones and material for art and decorative work, not to mention agates, sardonyx, opals and other precious stones. The difficulties in the way of mining these products are pointed out and ways of surmounting them suggested by the writer. Under existing conditions the mountain land of this region is practically valueless, and for lack of irrigation the flats are becoming less fertile from year to year. (Fourth Ann. Rept., 1892, Geol. Surv. Texas, Austin, 1893.)

Estimates of the Duration of the Glacial Epoch.—At a recent meeting of the Geological Society of America, Mr. Warren Upham

showed by a comparison of the shore erosion and accumulation of beach gravel and sand by the waves of Lake Agassiz with those of Lake Michigan that the existence of the former might be estimated at not more than 1000 years; the moraines belonging to the area of the later drift were probably formed in twice that time; the recession of the ice from its outermost limit to the first of these moraines a similar length of time, or perhaps, longer. In these conclusions the author agrees with Prestwich, who estimates the epoch of extreme cold at 15,000 to 25,000 years, and the melting of the ice-sheet to from 8,000 to 10,000 years or less.

In order to show that his conclusion as to the age of Lake Agassiz is consistent with the known records and inferred conditions of the Ice age upon the central belt of the North American continent, Mr. Upham reviews the series of formations in the Mississippi and Nelson river basins which belong to the times immediately preceding, during and following the Glacial period, especially considering the changes in the altitude and slopes of the land and the probable measures of time demanded by the processes of drift transportation and deposition, by subsequent weathering with soil formation, and stream erosion. As a result of his investigations, he gives the following estimates of the duration of the three parts of the Cenozoic period under study, arranged in chronological order:

"The time of preglacial epeirogenic elevation, with the deposition and erosion of the Lafayette beds, some 60,000 to 120,000 years; the Glacial period, regarded as continuous, without interglacial epochs, attending the culmination of the uplift, but terminating after the subsidence of the glaciated region, 20,000 to 30,000 years, and the Postglacial or recent period, extending to the present time, 6000 to 10,000 years. In total the Plistocene era in North America, therefore, has comprised probably about 100,000 or 150,000 years, its latest third or fourth part being the Ice age and subsequent time. The pre-plistocenic Cenozoic era appears by changes of its marine molluscan faunas to have been vastly longer, having comprised, perhaps, between two and four million years, of which the Pliocene period would be a sixth or eighth part, thus exceeding the whole of the ensuing era of great epeirogenic movements and resulting glaciation."

In the discussion which followed the reading of Mr. Upham's paper, Mr. McGee called attention to the unmistakable unconformity between the Columbia and Lafayette formations in the Coastal plain series. This unconformity represents erosion approaching 1000 feet in depth in the Lower Mississippi region and from 300 to 500 or more feet in depth in

the embouchures of the other rivers of the Coastal plain. It is represented not only by the removal of fully one-half of the original volume of the Lafayette formation, but by the degradation of an equal or greater volume of subjacent formations of Neocene, Eocene and Cretaceous age beneath. (Bull. Geol. Soc. Am., Vol. 5, 1894.)

In a previous publication in the same periodical, Mr. Upham had concluded that the observed volume of the Plistocene glacial erosion and resulting drift had probably accumulated in from 10,000 to 20,000 years. In the general conclusion of a short rather than a long period, Mr. R. S. Tarr agrees, but cannot accept Mr. Upham's line of argument, with our present knowledge of the rate of glacial erosion. Various complex factors make a time estimate of little value. Mr. Tarr bases his estimate on the following conditions.

A glacier is supplied with material for erosive work in three ways: (1) it may carry along the loose material in its path; (2) it may rend rocks asunder whenever a place of entry is found; (3) it may obtain material from the rock itself by scouring it with cutting tools already supplied. The erosive action of ice is to round, smooth and polish the surface over which it moves, lessening the possibility of obtaining a supply of cutting tools, so that as the period of ice occupancy lengthens the power of erosion diminishes.

With these facts as a basis, a young glaciated region should be littered with glacial drift, the products of disintegration. In a later stage the deposits would be composed of fresher rock fragments distributed in greatest abundance near the periphery of the ice-sheet. During old age the country would be free from deposits and the topography would consist of polished, rounded hills of glacial erosion. The first stage would be brief, the second longer, and the passage to extreme old age one of slow development.

In accordance with these facts, Mr. Tarr concludes that the North American glaciated region is topographically young, or at most not far advanced into maturity. (Am. Geol., Vol. XII. 1893.)

Geology of Marthas Vineyard.—After a personal investigation of the geology of Marthas Vineyard, Mr. Hollick finds that the ridge of hills consisting of a superstructure of contorted clay strata capped and flanked to the north with till, is composed of material derived from cretaceous and post-cretaceous strata. He does not agree with Shaler that the dislocations and elevations of the strata are due to mountain-building forces, but that they can be accounted for by the same theory that the author advanced for the modification of the strata

of Long Island and Staten Island which is to the south of former cretaceous areas, viz., that the clays have been eroded and ploughed up in masses, and the strata folded or squeezed up and shoved ahead by an advancing ice-sheet, which, upon melting, left them as hills or ridges of dislocated, contorted material covered by the englacial and super-glacial till. (Trans. N. Y., Acad. Sci., XIII, 1894.)

Plistocene Birds of Madagascar.—An important collection of bird bones from Madagascar has been received by the Academie des Sciences de Paris. According to MM. Milne-Edwards and Grandidier these bones indicate that at a period not remote, certaintly contemporary with man, Madagascar was inhabited by 12 species, at least, of gigantic birds, incapable of flight, but provided with immense feet. Two types are distinguished: the first, Æpyornis, comprising 8 or 9 species; the second, named by the author Mullerornis, characterized by a lighter body, and a shorter tail than the first, comprises but 3 species. The conditions under which these bones were found shows that the bird lived on the shores of water, with troups of small hippopotami, crocodiles and turtles. (Revue Scientifique, Jan., 1894.)

Antennæ in Trilobites.—In the American Journal of Science, August, 1893, Mr. W. D. Matthew puts on record the important discovery of antennæ in *Triarthrus beckii*, and gives illustrations of a number of this species showing these appendages. The specimens were collected by Mr. Valiant in the Hudson River shales near Rome, N. Y. Walcott suspected an antennal system in the Trilobites, and looked for it by means of sections, but failed to find a trace.

In discussing this valuable addition to biological knowledge, Mr. H. M. Bernard (Nature, Oct. 12, 1893) refers to the appearance and position of the antennæ as described by Mr. Matthew and draws the following conclusions:

"(1) All trilobites had antennæ, which except, as far as we know, in the case of *Triarthrus beckii* alone, remained shut in under the head shield.

"(2) These ventrally placed antennæ were inserted, approximately, one on each side of the labrum.

"It seems to me that these natural conclusions from the facts go far to establish the relationship originally maintained by Burmeister, and recently elaborated by the present writer (The Apodidæ, Nature Series, 1892). But however weighty the arguments (amounting, it seemed to me, to a proof) in favor of this relationship, the inability actually to

demonstrate the existence of the antennæ was a felt weakness. That weakness has now been finally removed, and my arguments have been fully confirmed by the finding that the Trilobites had antennæ in practically the same position as the anterior pair in the Apodidæ.

"The Trilobites may, therefore, take a firm place at the root of the Crustacean system, with the existing Apus as their nearest ally."

Development of the Brachial Supports in Dielasma and Zygospira.—Some interesting results have been obtained by Messrs. Beecher and Schuchert in studying the development of the brachial supports of the Terebratellidæ. Some of the latest are embodied in a paper published in the Proceeds. Biol. Soc. Washington, 1893, in which the authors show that the most primitive form of the loop in the Ancylobrachia is centronelloid and that therefore Centronella represents a larval or immature condition of the higher genera. For demonstration the authors use the paleozoic species, *Dielasma turgida* and give drawings of six sections to show the development of the loop.

It is also shown that in *Zygospira recurvirostra* the primitive arm support is a terebratuloid loop having a Centronella form, which undergoes several modifications before the growth of the spiral lamellæ, in so far resembling the development of Dielasma. The spirals then develop as two slender converging lamellæ, curving toward the ventral valve, originating from the outer pointed ends of the loop. When maturity is attained there are about three volutions in each spiral cone. Sectional drawings illustrate this series of changes.

Zygospira is the earliest spire-bearing genus known, and from the study of the ontogeny and phylogeny of its species the authors conclude that the Ancylobrachia are older and more primitive than the Helicopegmata.

According to the authors these results throw doubt on a number of Lower and Upper Silurian species described as having recurved loops and previously referred to Macandrevia or Waldheimia. The facts indicate that *Waldheimia mawii*, described by Davidson, is the young of *Davia navicula* Sowerby.

Geological News.—Mesozoic.—In a recent journey across the plateau of Shan-si, China, Mr. Obrucheff discovered some fossil plants in the middle parts of the series of deposits which cover in China, the carboniferous formation, and which Richthofen had described under the names of *Meberkohlen-sandsteine* or *Plateau-sandsteine*. These plants indicate that the middle portions of this formation belong to the Mesozoic age, and are Triassic or Liassic. (Nature, Jan., 1894.)

In a report on the Cretaceous area north of the Colorado Mr. J. A. Taff shows the detail of stratigraphy in four sectional views which give a concise view of the variations in thickness and structure and the relations of each division and formation to its associate divisions or formations, from the Brazos river on the south to the Red river valley on the north. Some attention is given to the soils of this region, and considerable definite information concerning the artesian water supply. The stratigraphic work is largely based on the paleontological determinations of Prof. F. W. Cragin.

Prof. Cope recently described two new species of Plesiosauroids from the Pierre formation of the Upper Cretaceous of South Dakota, under the names *Embaphias circulosus* and *Elasmosaurus intermedius*. The first named represents a new genus allied to Pliosaurus, having a short neck and strongly biconcave vertebræ. He also described the construction of the posterior part of the skull in another Plesiosauroid, the *Cimoliasaurus snovii* of Williston, showing that the supratemporal and supramastoid bones are both present and distinct. (Proceeds Amer. Philosoph. Soc.).

Cenozoic.—As to the origin of certain hydrocarbons of Utah, Mr. M. E. Jones considers the theory of an animal origin advocated by Newberry to be the only tenable one. The deposits with one possible exception, are all either Eocene or Miocene, and their source, according to the author, being the overlying or adjacent bituminous beds. These remarks apply only to the deposits situated near the coal beds of Utah in the neighberhood of Pleasant Valley Junction. (Science Dec. 1893.)

ZOOLOGY.

The Irritability of Noctiluca.—M. Jean Massart has been conducting a series of experiments to ascertain to what stimulants the Noctilucæ respond, as shown by their phosphorescence, and to what extent the phosphorescence is modified by exterior agencies. The author finds that these organisms are sensitive (1) to a slight agitation of the water, (2) to sudden variations in the temperature and density of the water, and (3) to a great number of chemical substances. As to the first stimulant mentioned, the author discovered, by an ingenious experiment, that the agitation of the water produces a deformation of the body of the Noctiluca, and it is this deformation which causes the phosphorescence, and not a vibration transferred to the animal from the water in motion. The experiments testing the effect of certain volatile substances upon the organisms are exceedingly interesting. Amyline produces hyperesthesia, the light is more intense than in normal individuals. This condition lasts for five minutes, then all is dark. At a slight blow on the vessel the phosphorescence reappears, showing that sensibility has not been lost. Bromoform acts as an anesthetic. For about five minutes the Noctiluca subjected to its influence emit a feeble light which slowly fades out. At the end of twenty-five minutes the light is almost imperceptible; anesthesia persists. After twenty hours the normal state is recovered. The effect of acetone is similar, but more rapid in action. At the end of five minutes the phosphorescence disappears entirely, and at the end of twenty-eight minutes a slight tap on the vessel causes a diffused light, which persists for some seconds showing a return to the normal state.

Some substances produce anesthesia immediately, without any display of irritability (alcohol, methyl and paraldehyde); others result in the death of the organism without any luminous reaction (piperidine). Chlorhydrate of morphine and metaphosphate of sodium appear to have no effect upon the Noctiluca, which is astonishing since the latter substance is considered an energetic coagulant of the albuminoids.

While a slight agitation of the water containing Noctiluca increases the phosphorescent light, a violent shaking destroys it. This the author believes, is due to a blunting of the sensibility of the organism to the shock. A few minutes in quiet and darkness restores the animal to its normal irritability.

In general, the Noctiluca responds more readily to stimuli at night than in the day-time, and this is true even under artificial conditions. For instance, the record of one set of animals kept in the light from the beginning to the end of the experiment, and that of another kept in the dark is almost identical. M. Massart is inclined to attribute this regular variation of sensitiveness to memory on the part of the animal rather than to the influence of light, and his experiments would appear to prove his theory.

That the irritability of the Noctiluca varies with the temperature and density of the water is demonstrated in a few carefully conducted experiments, the results of which are given in tabulated form. Incidentally, M. Massart observed that the normal specific gravity of the the Noctiluca is 1.014, but that this is increased or lessened with the varying density of the water.

In conclusion, the author calls attention to the analogy between the irritability of the *Mimosa pudica* and that of the Noctiluca, the one manifesting itself in movement, the other by the emission of light. (Bull. Sci. de la France et de la Belgique, T. XXV, 1er Partie, 1893.)

The Production of Sound Among the Ants.—That ants have some means of communicating with each other is well-established. The experiments of Landois and those of Lubbock suggest that this communication is carried on by means of sounds produced and heard by these small creatures, but which the human ear is incapable of appreciating. The observations of M. C. Janet, published in *Ann. Entomol. de France* (Vol. LXII, p. 159) show that certain species of the Formicidae, notably *Myrmica rubra* L. and *Tetramorium cæspitum* L., are in the habit of making a stridulating noise, probably by reciprocally rubbing superficial parts of the body. A demonstration of this fact is very simple. On a small pane of glass put a ring of soft putty, and after carefully dropping in the middle of the ring, by means of a funnel, a mass of ants freed from bits of earth or vegetable matter, quickly cover them with a second pane of glass and press it down until there is just barely room between the two pieces of glass for the ants to move. If provision has been made for renewal of air the imprisoned ants will live for several days. On holding this little box of ants to the ear and listening attentively, a murmur is heard very similar to that made by a liquid boiling gently in a closed vessel, and before long distinct stridulations can be heard in the midst of the murmuring. These sounds are heard only when the ants are disturbed.

M. Janet concludes that the numerous rugose surfaces which are found on the body of ants in such places that two of them can be rubbed together, are probably the organs which produce the stridulating sounds of the Formicidae. These rugosities have other uses. For instance, those about the articulations serve to hold the body stiff at will at that particular point, an advantage to the animal in pushing or carrying heavy weights up steep slopes. (Revue Scientifique, January, 1894.)

Zoological News—Mollusca.—Mr. J. I. Peck's report on the Pteropods and Heteropods collected by the U. S. Fish Commission steamer Albatross, during the voyage from Norfolk Va., to San Francisco, Cal., 1887–88, is published in the Proceeds. U. S. Natl. Mus., Vol. XVI. The material is the result of both dredging and surface collection. The Pteropods belong almost exclusively to the family Cavoliniidae, representing all the species except one of the genus Cavolinia, the species of Cuvierina, as also six of Clio. The Heteropods are included in the three genera Atlanta, Carinaria and Ianthina. According to the author, results show that there are no marked distinctions between the kinds and distribution in the Atlantic and Pacific waters of northern South America.

Urochorda—A new Tunicate from the Pacific Coast is described by Mr. W. E. Ritter, who assigns it to the genus Perophora. The new species presents an interesting character. In very many, though not all of the colonies, the ascidiozooids are as completely imbedded in a common test as they are in Botryllus or Goodsiria. In recognition of this transitional character the author proposes for it *annectens* as a specific name. (Cal. Acad. Sci., Vol. IV, 1893.)

Mammalia—Two new Neotomæ from the Plateau region of Arizona are described by C. Hart Merriam. One of the new species, *N. arizonæ*, presents a remarkable combination of the external characters of the bushy-tailed wood rats with the cranial characters of the round-tailed species. The other, *N. pinetorum*, is a round-tailed species allied to the *N. fuscipes* group of California. In this connection Mr. Merriam calls attention to an important cranial character, heretofore overlooked, which serves to distinguish *Teonoma* from *Neotoma*. In the skulls of the round-tailed wood rats there is a long open slit on each side of the presphenoid and anterior third of the basisphenoid. These openings the author designates the *spheno-palatine vacuities*. (Proceeds. Biol. Soc. Wash., 1893.)

EMBRYOLOGY.[1]

Cleavage and the Formation of Organs.—An important addition to the accumulations of experimental embryology has been recently made by Oscar Hertwig[2] in the hope of clearing up the fogs that envelop the important subject of the relations of the cells of a cleaving ovum to the subsequently formed organs of the adult.

While His, Roux and Weismann have seen in the ovum or germ a preformation of parts or organs and looked upon the cleavage cells as different in quality from the first, regarding the process of embryo formation as an evolution (in the old sense), Driesch and Hertwig, from experimental studies, now regard the ovum as *isotropic,* its first cells are qualitively alike, the embryology is an epiginetic formation of organs. The process is one of inter-relation of the cleavage cells.

In the present paper the author describes a long series of experiments made upon frogs' eggs and applies them to the overthrow of Roux's main position, meeting that investigator upon his own grounds.

The methods used are: the compressing of the eggs between glass slides placed horizontally, vertically or inclined; the compressing of the eggs by drawing them into narrow glass tubes placed horizontally or vertically; the partial separation of the first two cleavage cells (in the Triton) by means of a loop of fibre from a cocoon tied about the the egg; the injury of one of the first two cells by the insertion of a needle; and the same result by the use of an electric current, continuous or interrupted.

We will first give some of the chief facts obtained by each method and then the author's conclusions.

When the eggs lie in the normal position upon a glass slide but are compressed by the slide that rests upon them so as to be no longer spherical but considerably flattened, the main axis from the black to the light pole being thus made the shorter, by a third or a fourth, the eggs cleave in an abnormal manner. The third plane is not horizontal but more nearly vertical so that the first eight cells form a bilaterally symmetrical set of four on each side the second cleavage plane. Again, if the pressure is exerted upon the sides of the egg, which is done by plac-

[1]Edited by E. A. Andrews, Baltimore, Md., to whom communications may be sent.

[2]Archiv fr Mik. Anatomie. 42. 22 Dezember, 1893, pps. 662–794, Pls. 39–44.

ing the slide vertical and allowing the eggs to take up their normal position before the second slide is pressed upon them, the cleavage is abnormal. The second plane is not a vertical one but is horizontal so that two black-pole cells and two light-pole cells are formed. The two former cells are very small and divide up by somewhat vertical planes parallel to the first. Thus the second, normal, plane remains long absent. When the plates are inclined to 45° a still different modification of cleavage results.

The eggs that are drawn into narrow tubes are distorted into cylindrical or barrel-shaped masses that cleave abnormally. When the tube rests horizontally the first plane is vertical or normal but always at right angles to the axis of the tube, the second is normal, that is, at right angles to the first, but the third is also vertical and not horizontal: the fourth is horizontal.

When the tube is placed vertically the black part of the egg is uppermost and the cleavage is again altered by the pressure of the tube. The first plane is oblique and variable, but divides off a smaller upper cell from a larger lower cell.

All these abnormal modes of cleavage may, the author maintains, be explained upon his principle that the cleavage plane is at right angles to the axis of the nuclear spindle and that the position of the spindle-axis is dependant upon the shape and character of the protoplasm about it; the poles of the spindle lie in the directions of the greatest masses of protoplasm. Pressure acts by changing the shape of the protoplasmic mass and thus inducing a new direction for the nuclear spindles. That in the frog different forms of cleavage result when the egg is pressed from the side or from above downward is to be explained by the quality of the protoplasmic masses, the nature of the protoplasm, admixture of yolk, etc. being a factor as well as its mass in regulating the direction of the nuclear spindle. This explanation is thus more fundamental than the principles of surface tension and rectangular intersections of cleavage planes, which follow in part from this action of mass upon nuclear arrangement.

If the eggs remain under pressure between the plates or in the tubes they continue to develop, form gastrulas and, in some cases, larvæ. This furnishes a good means of confirming the contention of Pfluger and of Roux that the medullary folds really are formed upon that side of the egg which is at first the light colored lower side though they normally appear upon the upper side and would hence be naturally regarded as formed from the black or animal-pole side.

Between horizontal glass plates the gastrulation takes place so that the crescentic blastopore lip appears upon the edge of the lower side of the disk-shaped egg, at any point of this periphery. It then travels, in some way not observed, across the lower, flat surface, and closes at a point of the periphery diametrically opposite to that whence it started. Now in sections it is found that the yolk mass is at first at the end near the first position of the blastopore, then shifting, lies at the other end.

If the egg were free and not held fast by the pressing plates this shifting of the center of gravity would tend to revolve the egg so that its lighter colored part would become uppermost. Meanwhile the head fold and medullary folds come in near and along the region traversed by the blastopore (they are found upon the flat *under* side of the compressed egg) and hence would normally appear upon the upper side if this rolling of the egg took place.

Passing over some other interesting observations we may mention those made upon eggs that were forced to develop up-side-down. This was done by turning them over, under pressure, after the first or second cleavages. The light colored part of the egg thus remains uppermost The eggs develop normally at first but finally when gastrulation begins the blastopore is irregular in shape and the yolk is asymetrically distributed so that very imperfect and monstrous gastrulas result.

An attempt to separate the first two cells of tritons by drawing a loop of fine silk about the constriction between them did not succeed, since the two cells remained connected by an isthmus. Yet as they were held partly apart some curious modifications in the development resulted. The results are, however, very diverse. Each cell may cleave and a dumbell-shaped blastula result and eventually a monstrous embryo formed half upon one side of the thread, half upon the other or chiefly upon one side and partly upon the other. The nervous system may be outlined altogether upon one of the parts kept apart by the thread.

What may be considered the most important part of the paper is that treating of Hertwig's repetition of Roux's experiments upon the development of frogs eggs in which one of the first two cells is destroyed or injured by needle thrusts.

Such eggs continue to develop, but produce abnormal embryos. Roux maintained that the uninjured half of the egg formed a half blastula, half-gastrula, etc. Hertwig claims that this is not the case and figures many sections that support his claim very convincingly.

The development of the uninjured half of the egg is not as it would be in an entire egg but is so modified by the presence of a partly dead mass adjacent to it that it produces what may be called rather an abnormal blastula with an inclusion of inactive or dead yolk than in any sense a half-blastula.

Later, abnormal gastrulas are formed. These, however, are not *Semigastrulæ laterales*, *anteriores* or *posteriores* as Roux describes, but gastrulæ checked and distorted in their formation.

It seems, moreover, that only the presence of the inactive or dead yolk of the injured cell prevents the living cell from developing into a complete small gastrula as in the echinoderm experiments of Driesch. This dead or injured mass remains intimately attached to the live cell and hence is incorporated as a part of the embryo which it modifies somewhat as the yolk of a meroblastic egg modifies the part that forms the embryo.

Some eggs develop even the medullary folds and the notochord and form parts of larvæ. These are, however, very incomplete and also much varied in character; since, apparently, the injured cell is killed, coagulated, only in the part near the needle hole and may become, elsewhere, utilized as part of the embryo, this embryo will be more or less perfect according as the needle thrust has destroyed more or less and even according as it has destroyed one part or another of the cell, for thus the dead part will come to occupy a ventral or a dorsal position, etc., in the embryo.

This description of the formation of embryos that are more or less complete, according as the mass of inert substance is less or greater, is strongly opposed to the conception of Roux that, namely, the half egg first formed a half embryo. Yet Roux allowed that a more complete embryo was *subsequently* formed from the half by a process of revivification of the inert half, by what he called postgeneration. The ultimate result is thus the same according to either investigator.

Moreover Hertwig concedes that some process of "postgeneration" takes place to convert part of the inert mass into active cells; the injury to the cell having been in part but temporary so that it may later take part in forming the embryo.

While Roux insists upon the power of one cell to develop by itself as a half embryo and then to coerce the inactive half into the subsequent formation of the complete embryo, Hertwig lays stress upon the continuity and uniformity ot a process that is from the first a formation of a whole embryo by the half-egg, subsequently, in part, assisted by the slow acting injured half.

With an omission of a critique upon Roux's conceptions of developmental processes we pass to the general conclusions that end the paper

Pressure that changes the shape of the amphibian egg induces great changes in the directions and sequence of the cleavage planes and in the size of the cells.

The direction of the planes results from the form of the cell and the distribution of its protoplasm.

There is no causal connection between the first planes and the axes of the body; the main axis of the body is not determined by the position of the first or second cleavage planes.

In the various induced forms of cleavage the nuclei that are formed become, in the different cases, distributed to very various parts of the yolk; they may be vicariously distributed to all parts of the yolk.

As the cleavage does not separate parts of the yolk predestined to form definite parts of the animal, so also the nuclei are not qualitatively divided into different kinds of nuclear material for the various cells. Yet normal embryos with normally placed organs arise from such mixed up or unnaturally distributed nuclei.

The egg contains no definite substance set apart to form special organs (liver-, skin-, retina-forming material) but it is isotropic. The contents of the egg ceases to be isotropic and becomes more and more specialized and organized in the process of cell multiplication with its important chemico-physical transformations (such as increase in the nuclear material).

In spite of this isotropy the egg is a definitely organized cell with yolk, protoplasm, etc., of different specific gravity.

This specific nature of the egg contents and also the shape of the egg exercises a directive influence over the process of development; the embryo at first must be adapted to the form of the egg.

The shape and position of the egg determine the position of the first cleavage planes.

As no rearrangement of heavy and light portions takes place in cleavage the distribution of mass in the egg corresponds to that in the blastula.

When the walls of the blastula are not uniform the gastrulation can take place only in a special zone which is below the equator when there is less yolk, as in the amphibian egg, and above when there is very much yolk, as in meroblastic eggs.

From an oval or elongated egg there is formed an elongated blastula, gastrula, etc. (in triton and insects, etc.).

As many eggs have elso a bilateral arrangement of their component substances there must follow a bilateral blastula in which the place for formation of the blastopore will be more sharply defined.

The chief axes of the embryo may correspond approximately to the first cleavage planes in eggs that are bilaterally symmetrical or that have one long diameter, since the character of the egg determines both.

In the gastrulation of the amphibian egg there is a revolution about an axis cutting the plane of symmetry and the plane of equilibrium.

Eggs of complex consistency are acted upon by gravitation so that they are oriented and if bilaterally symmetrical stand with the plane of symmetry vertical since this is also the plane of equilibrium.

If such eggs are forced to develop in a constrained position they form asymmetrical embryos so that gravitation is, in a sense, one of the influences determining structure.

If one of the first two cells of the egg is destroyed the other develops into a tolerably normal embryo having, however, some of its less important regions defective.

When one cell is but partly destroyed it may later form cells that are added to the uninjured half to help form the embryo. This secondary formation of cells in the injured half may be from the uninjured nucleus of that cell, or sometimes, by the migration of nuclei from the uninjured egg-half into the injured egg-half.

The development of the uninjured half, by itself or with the aid of part of the injured half, follows the same laws as the natural ontogeny of the species.

The injured yolk acts in the development of this half of the egg as the nutrient material does toward the formaitive in a meroblastic egg.

The process of postgeneration described by Roux does not take place nor is there a revivification of the destroyed egg-half.

Embryos with cleft blastopore cannot form double monsters by the process of postgeneration that Roux brought in to explain such a formation.

We cannot form at will half-anterior, -posterior or -lateral blastulas or embryos by destroying one of the first two cleavages cells.

In these cases of injury complex processes of adjustment may result in the formation of a normal embryo under changed circumstances.

The results obtained by these pressure experiments as well as the injury to one of the cleavage cells demonstrate the untenability of the mosaic theory, the theory of specialized germ areas and Weismann's theory of germ plasm.

The egg is a specifically organized one-celled organism that develops epigenetically by process of multiplication of cells with subsequent differentiation.

Since each cell comes from the first (the egg) by division it likewise contains the beginnings of the whole and becomes differentiated and specific during process of development according to the position it occupies in the whole at any period (gastrula, etc.). The reasons leading up to this position may be put under the following seven heads: 1. A complete organism may be formed from one of the first two or four cells; accordingly in different cases cells of like origin must be put to forming different organs. 2. As the gastrula mouth may appear at various parts of the periphery the cells concerned must have different ates in different cases. 3. The same is true in the abnormal cases of formation of multiple gastrula mouths; then there may be formed four instead of two eyes, ears, etc. 4. Frog's eggs that develop when held up-side-down must have the material utilized in a different way from the normal. 5. Thus also the triton larvæ show various ways of using the similar cells when the first two are partly separated by a thread. 6. When the frog develops up-side-down cases occur in which the lip of the blastopore is rolled outward and unites with the other lip so that the line of union is not between the edges of the lips but between the edge of one and the turning out surface of the other. Then the notochord and the medullary plate would be formed from cells quite other than those normally acting. 7. Changes in the cleavage process that so mix up the nuclear substance that it is assigned to different parts of the yolk in different eggs have no influence upon the normal result of development.

Thus in place of the mosaic theory of Roux and the germ-plasm theory of Weismann we may substitute the theory of the controlling inter-adjustments of the embryonic cells and later of the tissues and organs.

ENTOMOLOGY.[1]

The Four-lined Leaf-bug.—Another satisfactory monograph of a hitherto little-known injurious insect comes from the Cornell University Agricultural Experiment Station.[2] Mr. Slingerland reports that *Pœcilocapsus lineatus* has been destructive to currant foliage in New York for several years, sometimes rivalling, in damage done, the common currant-worm. Bushes on the university grounds "looked as though a fire had swept over them, leaving the prominent topmost leaves brown and dead." Such injury checks the growth of the bushes and materially lessens their productive capacity the following season. The past history of the insect is reviewed at some length, the discussion showing that it has been recognized as a destructive species for many years.

The four-lined leaf-bug shows an extraordinary range of food-plants, 54 species being listed as attacked by it. "Botanically considered, these lists are of interest, as they show an exceedingly wide range of food-plants for a single species of insect. Rarely do we find an insect attacking indiscriminately so many different plants with such widely different characteristics. The fifty-four species of plants represent forty-nine genera in thirty-one different families of the Flowering Plants. The Gymnosperms, like the pine, etc., are not represented, and but one genus (*Hemerocallis*) of the Monocotyledons. Fourteen of the plants are useful for food or medicine; twenty-nine are ornamental; while but eleven are wild species. Thus the beneficial results from the attack, rarely severe, of the insect upon the weeds, so termed, is slight compared with its frequently very injurious attacks upon the cultivated plants."

"The insect usually makes its first appearance in New York about the middle of May on the newest, tenderest terminal leaves. The insects are then so small and active in hiding themselves that they are not apt to attract attention. Their work, however, soon becomes apparent. Minute semi-transparent darkish spots appear on the terminal leaves. These spots are scarcely larger than a commonpin's head, and are round or slightly angular in shape, depending upon the direction of the minute veinlets of the leaf which bound them. The insect has inserted its beak into the leaf and sucked out nearly all of the opaque green pulp or parenchyma of the interior within a small area bounded by the little veinlets." These spots later turn brown

[1]Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Bull. 58. The Four-lined Leaf-bug. By Mark Vernon Slingerland. October, 1893.

and die; and, eventually, as the insects increase in size and destructive power, the leaves become withered and dead, as represented in Fig. 2 of the accompanying plate. "When all the tenderest leaves have succumbed, the insect continues its attack on the older leaves lower down. During its lifetime a single insect will destroy at least two or three currant or gooseberry leaves. This accounts for the fact that the injury wrought often seems much out of proportion to the number of insects at work.

FIG. 1.—The adult insect; its natural size represented in small figure at the right.

"When the insects are very numerous, the growth of the shoots is often checked, they droop, wither, and die. Some have thought that this blasting of the growth was caused by a poisonous saliva which the insect injected into the wound made by its beak. However, it is more probable that the shoot dies or its growth is checked on account of the death of its breathing organs—the leaves. On the currant, gooseberry, and many other plants the insect confines its attacks to the leaves, but on some ornamental plants, as the dahlia and rose, the most frequent point of attack seems to be the buds."

Mr. Slingerland has, for the first time, traced the annual cycle of this pest. He finds that "the nymphs appear in the latter part of May upon shrubby plants where they continue to feed upon the tender leaves for two or three weeks, undergoing five moults. The adults appear early in June and often spread to different surrounding succulent plants. Egg-laying begins in the latter part of June; the eggs being laid in slits cut in the stems of shrubs near the tips of the new growth. The adults disappear in July and the insect hibernates in the egg. Only one brood occurs each year in our State."

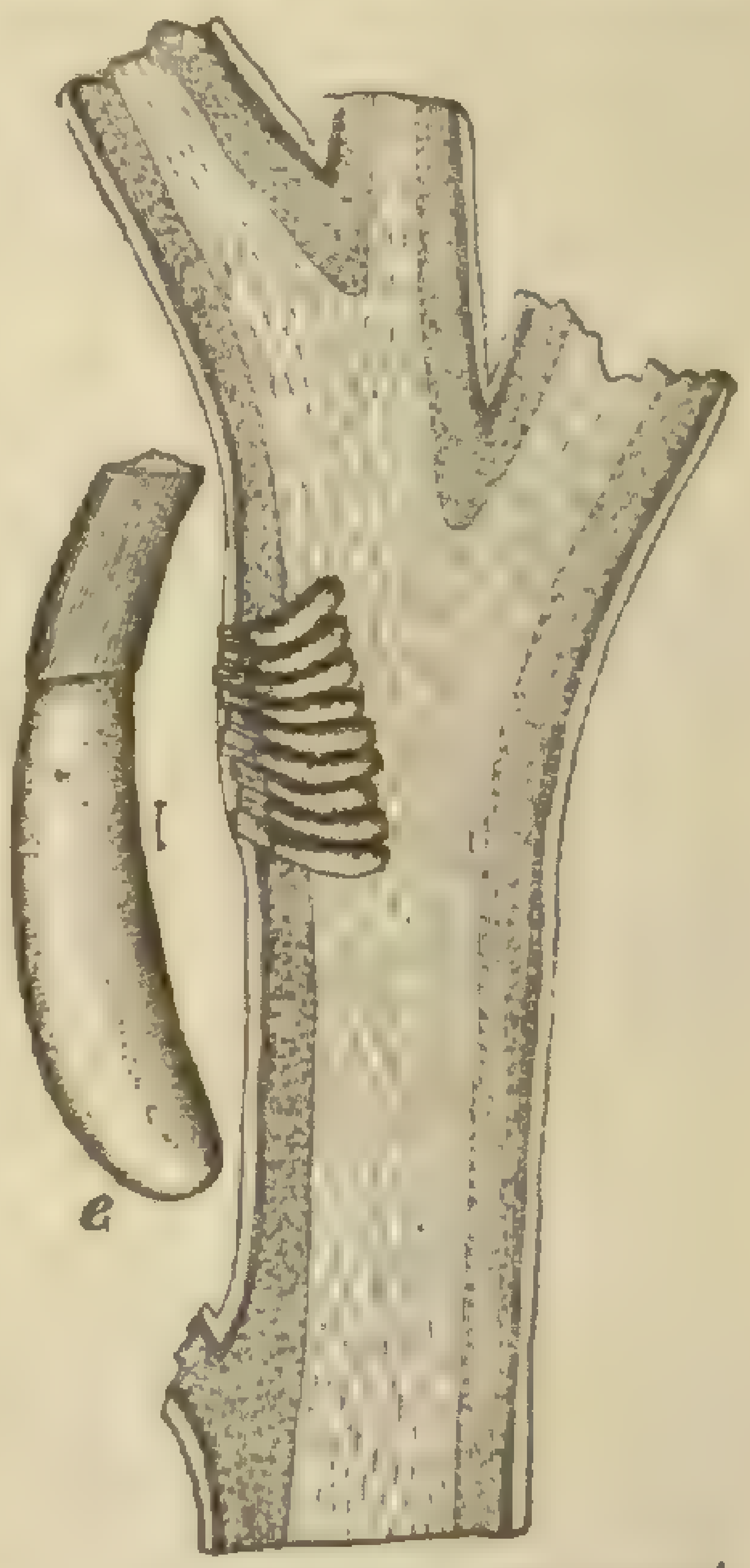

FIG. 2.—Section of currant stem showing eggs in position; *e*, egg, greatly enlarged.

The eggs are deposited in the stems, several being placed side by side in a longitudinal row (Fig. 2). The egg clusters as they appear on the surface of the young shoots are represen-

ted in the upper figure of the accompanying plate. After much experimenting, Mr. Slingerland finds that "there are three practicable methods by which this pest can be controlled: kerosene emulsion for the nymphs; destruction of the eggs by pruning; and the capture of the nymphs and adults by jarring into receptacles where they are destroyed. Circumstances will largely determine which method will prove the most practicable in specific cases."

The bulletin concludes with an extended bibliography and synonymy, and is represented by 13 figures, four of which are reproduced herewith.

Indiana Orthoptera.—Two important papers, by Mr. W. S. Blatchley of the Terre Haute High School, have recently appeared.[3] The first is entitled the Locustidæ of Indiana, thirty-nine species being catalogued, while a list of twelve others that are likely to be found in the State is given.

Concerning the musical powers and general habits of these katydids and their allies, Mr. Blatchley writes: "The stridulating or musical organ of the males is quite similar to that of the male cricket, being found at the base of the overlapping dorsal surface of the tegmina, and usually consisting of a transparent membrane of a more or less rounded form, which is crossed by a prominent curved vein, which, on the under side, bears a single row of minute file-like teeth. In stridulating the wing covers are moved apart and then shuffled together again when these teeth are rubbed over a vein on the upper surface of the other wing cover, producing the familiar so-called 'katydid' sound. Each of the different species makes a distinct call or note of its own, and many of them have two calls, one of which they use by night and the other by day. Anyone who will pay close attention to these differ-

Fig. 3. A Locustid. [after Bruner].

ent calls, can soon learn to distinguish each species by its note as readily as the ornithologist can recognize different species of birds in the same

[3] Proceedings Indiana Acad. Science, 1892, pp. 92–165.

manner. The ear of these insects, when present, is also similar in structure and position to that of the crickets, being an oblong or oval cavity covered with a transparent or whitish membrane, and situated near the basal end of the front tibiæ.

"The young of the Locustidæ, like those of the other families of the order, when hatched from the egg, resemble the adult in form, but are wholly wingless. As they increase in size they molt or shed their skin five times, the wings each time becoming more apparent, until after the fifth molt when they appear fully developed, and the insect is mature or full-grown, never increasing in size thereafter. Throughout their entire lives they are active, greedy feeders, mostly herbivorous in habit; and where present in numbers, necessarily do much damage to vegetation."

Mr. Blatchley's other paper is entitled "The Blattidæ of Indiana." Seven species belonging to five genera of cockroaches are catalogued.

"From the other Orthoptera the Blattidæ differ widely in the manner of oviposition, as the eggs are not laid one at a time, but all at once in a peculiar capsule or egg case called an oötheca. These capsules vary in the different species as regards the size, shape and the number of eggs they contain, but they are all similar in structure. Each one is divided lengthwise by a membranous partition into two cells. Within each of these cells is a single row of cylindrical pouches, somewhat similar in appearance to those of a cartridge belt, and within each

FIG. 4.—Croton Bug: *a*, first stage; *b*, second stage; *c*, third stage; *d*, fourth stage; *e*, adult; *f*, adult female with egg-case; *g*, egg-case —enlarged; *h*, adult with wings spread—all natural size except *g*.

pouch is an egg. The female cockroach often runs about for several days with an oötheca protruding from the abdomen, but finally drops it in a suitable place, and from it the young in time emerge." An introduced tropical species, *Panchlora viridis*, is viviparous.

"All young cockroaches resemble the parents in form, but are wholly wingless, the wings not appearing until after the fifth or last molt. The young are often mistaken for mature individuals." The stages of the common "Croton Bug," as represented by Dr. Riley, are shown in Fig. 4.

A Curious Hemipteron.—About the middle of January I received a curious looking specimen of Hemiptera which was taken in an agricultural implement warehouse. Owing to the extremely warm weather, the creature was quite active, and at first glance resembled an animated bit of rusty metal upon legs.

It proved to be of the family Reduviidae, recognized according to Latrielle by the elongated head which is free from the thorax, prominent eyes and two ocelli, antennæ of moderate length, filiform toward the ends and stout incurved beak. The tarsi are three-jointed, and the legs long and fitted for running.

This insect could probably be classified with *Reduvius personatus*, although of a reddish-brown rather than black, as members of this genus are said to have a habit of enveloping themselves in a thick coating of dust. This particular specimen was entirely covered with iron-dust and rust, possibly the only material at hand, and even the first joints of the antennæ and the densly hirsute limbs were thickly encased. The fourth hair-like antennal joints and the tarsi were clear of dust. Under the microscope numerous sharp, shining particles of steel and iron filings were to be seen, and the back, wingless and very concave, was heavily weighted. The insect moved rapidly, but with a peculiar creeping and halting gait, and proved to be very hard to kill. I first experimented with sulphur smoke, which had no perceptible effect. Then I placed the specimen in a prepared insect bottle, containing cyanide of potassium so strong that almost any soft bodied insect would become motionless instantly, and in this Reduvius lived several hours. Whether this was owing to the season of the year or to its unique coat of mail, I am unprepared to say.—LAURENE HIGHFIELD, *Quincy, Illinois.*

North American Membracidæ.—Dr. F. W. Goding has prepared a very useful catalogue of North American tree-hoppers.[4] Nearly three hundred species are included in the list, a considerable number of them being here described for the first time. Dr. Goding

[4] Bibliographical and Synonymical Catalogue of the Described Membracidæ of North America. By F. W. Goding, M. D., Ph.D. Bull. Ill. St. Lab. Nat. Hist., V. III, Art. XIV. Champaign, Ill., 1894.

has had access to ample collections and literature, and has filled nearly one hundred pages with the bibliography of this comparatively small family.

Colors of Lepidopterous Larvæ.—Prof. E. B. Poulton has an abstract of a memoir[5] entitled "The experimental proof that the colors of certain Lepidopterous Larvæ are largely due to the modified plant pigments derived from food." He divided into three lots one batch of eggs laid by *Tryphæna pronuba*, and fed them in darkness on green leaves, on yellow etiolated leaves and white midribs of cabbage. The last, whose food contained neither chlorophyll nor etiolin, were entirely unable to form the green or brown ground color.—*Journal Royal Microscopical Society.*

Effect of Arsenites on Caterpillars.—Professor C. H. Fernald reports[6] that in a series of experiments with various insecticides it was found that "gypsy caterpillars, when half-grown or larger, are not destroyed by any proportion of Paris green in water that can be used on fruit trees without injury to the foliage." A new insecticide—arsenate of lead—was tried with satisfactory results. "It did not injure even the most delicate foliage, however large a proportion was used. In one case, 24 pounds to 150 gallons of water were used without injury to the leaves."

Life-history of the Mole Cricket.—Some interesting details of the life-history of the European mole cricket (*Gryllotalpa vulgaris*) were recently communicated by M. F. Decaux to the *Societé Entomologique de France.*[7]

In some specimens under observation copulation took place April 15; the eggs were deposited by the end of April, and hatched May 15. At first the young are gregarious. All the young of a given brood do not mature at the same time; those maturing earliest reproduce 25 months after hatching, others 28 months, and a few even 35 months. These insects, M. Decaux says, are essentially carnivorous—feeding on insects, worms and slugs—but they accommodate themselves very well to a vegetable diet. He believes that the galleries are made not to pursue insects, but as places of defense and concealment.

News.—Prof. Charles Robertson has issued another instalment of his valuable papers on Flowers and Insects.

[5] Trans. Ent. Soc. London, 1893, pp. 255–265.
[6] Thirty-first Rep. Mass. Agr. College, p. 28.
[7] Bull. des Seances, No. 20, p. CCCXLI.

PLATE III.

FIG. 1.

FIG. 2.

Injuries of Four-lined Leaf-bug.

In his address as retiring president of the Cambridge Entomological Club, Mr. Wm. H. Ashmead discussed "The Habits of the Aculeate Hymenoptera." The address is being printed in *Psyche*, and is a paper of unusual biological interest.

Mr. F. J. Buckell discusses, at some length,[8] the proper name for the butterfly, variously known as *Danais archippus* or *Anosia plexippus*, and concludes that the insect should be called *Anosia archippus*.

Mrs. A. T. Slosson publishes[9] an interesting list of insects taken in the alpine region of Mt. Washington.

Mr. Howard Evarts Weed issues, as Bulletin 27 of the Mississippi Experiment Station a valuable discussion of insecticides, and their application.

In Bulletin No. 23 of the Maryland Experiment Station, Dr. C. V. Riley treats of some Injurious Insects of Maryland.

Mr. H. F. Wickham records[10] some interesting observations on the habits of oceanic Hemiptera. His observations indicate that Halobates may be drowned by submergence; and open up again the question as where these insects remain during stormy weather.

In his annual report on the gypsy moth, Prof. C. H. Fernald says: "In 1891, some experiments were made to determine what could be done toward entrapping the male moths by exposing females. In the spring of 1893, Prof. Shaler recommended that the monitor trap be tried on a large scale. This was done by enclosing the females in boxes covered on two sides by fine wire netting, and attaching to such boxes two sheets of paper covered with a resinous coating to which the male moths adhered. Fifteen traps were exposed in Malden, and 1,771 male moths were caught. The fact that so many moths were destroyed at a small expense, seems proof that trapping will prove an effectual and inexpensive method of preventing the increase in the numbers of the moth, especially as the males now seem to be comparatively scarce."

[8] Ent. Record, V. 1.
[9] Ent. News, V. 1.
[10] Ent. News. V. 33.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Indiana Academy of Sciences.—The Indiana Academy of Science held its ninth annual meeting in the rooms of the State Board of Agriculture, at the Capitol, Indianapolis, Dec. 27 and 28th, 1893, as stated in our last issue.

The following officers were elected for 1894.

President, Prof. W. A. Noyes, Rose Polytechnic Institute, Terre Haute; *Vice President*, A. W. Butler. Brookville; *Secretary*, Prof. C. A. Waldo, De Pauw University, Greencastle; *Ass't. Secretary*, Prof. W. W. Norman, De Pauw University, Greencastle; *Treasurer*, Prof. W. P. Shannon, Greensburg.

Boston Society of Natural History, January 3, 1894.—The following papers were read:—Mr. Leon S. Griswold, A brief description of the physical geography of Arkansas.

January 17.—The following papers were read: Mr. T. A. Jaggar, Experiments in the formation of ripple-marks. (Specimens were shown); Prof. N. S. Shaler, The topograpic evidence of ancient earthquakes.

Samuel Henshaw, *Secretary.*

The Biological Society of Washington, January 27.—The following communications were read: Mr. J. N. Rose, A Botanical Trip to Northwestern Wyoming. Mr. B. T. Galloway, A consideration of the Anatomical and Physiological Processes involved in Leaf Fall; Dr. Theo. Gill, The Segregation of the Osteophysarial Fishes as fresh water forms; Dr. C. W. Stiles, An Interesting Cestode from India.

The Annual Address of the President of the Biological Society was delivered by Prof. C. V. Riley, in the lecture room of the Columbian University, at half past eight o'clock on Monday evening, January 29, 1894. The subject was Social Insects from the Psychological and Evolutional Points of View.

Frederic A. Lucas, *Secretary.*

New York Academy of Sciences, Biological Section, January 29.—A paper was read by title, "A Case of reversed cleavage in a Sinistral Gasteropod," by Mr. H. C. Crampton, Jr.

Drawings were exhibited by Bashford Dean, showing original restorations of *Dipterus valenciennesii* S. & M., and of *Coelacanthus elegans* Newb.

Dr. J. L. Wortman exhibited an almost entire skeleton of *Patriofelis*, recently acquired by the American Museum of Natural History, and discussed its probable relationships. From structural characters of limbs he regards this creodont as nearest the ancestral form of the seals. Its spreading digits appear to have been webbed, and its coprolites show that its food material included turtles.

Dr. A. A. Julien read a paper on a newly discovered fungus from the petrified forest near Cairo, Egypt. Its genus is probably *Peronosporites*, and owing to remarkably perfect preservation its life history is to be determined.

BASHFORD DEAN, *Rec. Sec.*

SCIENTIFIC NEWS.

P. J. Van Beneden.—Professor Van Beneden, whose name is associated with the history of zoology, died recently, at the age of eighty-five years. One of his many contributions in aid of scientific work was the establishment, at his own expense, of a maritime laboratory at Ostend, which has since served as a model for others. His work extended throughout Zoology from the Protozoa to the Mammalia. At the time of his death he was one of the faculty of the University of Louvain.

Arthur Milnes Marshall, Professor of Biology in Owen's College, Manchester, England, who was as mentioned in our last issue killed recently by an accident, was both an investigator and a teacher of much ability, and was the author of many valuable biological papers, and of a text book of Embryology. He is remembered in the United States, which he visited in 1884, for his activity of both mind and body. His loss is greatly regretted. It is proposed now to erect a suitable memorial.

Paul Henri Fischer.—The Museum of Natural History of Paris has suffered a great loss in the person of Dr. Paul Henri Fischer, the well-known zoologist and paleontologist, who died on November 29, after a long and painful illness. Born at Paris, on July 7, 1835, he received his early classical and medical education at Bordeaux. He became *Tuterne des Hopitaux de Paris*, in 1859, and obtained his degree of Doctor of Medicine in 1863. The study of medicine did not prevent him from devoting himself also to that of the natural sciences;

for in 1861, he had entered as Demonstrator in the Laboratory of Paleontology of the Museum of Paris, under the direction of M. d'Archiac. His researches concerned above all the living and fossil Mollusca. Since 1886, he directed the *Journal de Conchyliologie,* in collaboration with M. Crosse. From the position of demonstrator he rose to be *aide-naturaliste* (assistant), and studied with great success the marine animals of the coast of France, their geographical and bathymetric distribution. He indicated the depths at which a large number of Foraminifera, Cœlenterata, Echinodermata, Mollusca, Bryozoa, etc., can be collected on the coasts of the west of France. In collaboration with the Marquis de Folen, he undertook the study of the animals dredged in the extremely interesting region of the Gulf of Gascogne to which the name "*Fosse du Cap Breton*" has been given. The two savants discovered a large number of form hitherto unknown, and many which recalled species only known in the fossil condition. With M. Delesse, he made researches on the submarine sediments of the French shores. He was elected member of the *Commission of Dredging,* and took part, from 1880 to 1883, on board the "*Travailleur*" and the "*Talisman*" in the celebrated expedition directed by Professor Milne-Edwards. In the course of these expeditions, he noted the enormous extension of a cold fauna characterised by boreal and Arctic species, and reaching as far as Senegal, where it lives beneath a superficial fauna with intertropical characters.

Among the writings of Fischer, which number not less than 300 titles, including books, pamphlets and memoirs, we may cite: *Paléontologie de l' Asie Mineure* (in collaboration with M. d'Archiac and M. deVerneuil); *Mollusques du Mexique et de l' Amérique centrale* (in collaboration with M. Crosse); *Species général et inconographie des coquilles vivantes; Animaux fossies du Mont Léberon* (in collaboration with M. Albert Gaudry and M. Tournouer); *Paléontologie de l'ile de Rhodes; Cétacés du Sud-ouest de la France; Catalogue et distribution géographique des Mollusques terrestres, fluviatiles et marins d' une partie de l' Indo-Chine; Sur les caractères de la faune conchyliologique terrestre et fluviatile récemment éteinte du Sahara; Sur la faune conchyliologique de l'ile d'Hainan (Chine);* numerous memoirs on the malacological fauna of Lord Howe Island (Pacific Ocean); of Cambodia, of the Caledonian Archipelago Islands, of the Bay of Suez, etc. In collaboration with M. E. L. Bouvier, he published papers on the anatomical peculiarities of certain groups of Molluscs. Finally he wrote a remarkable treatise on Conchology, which has become classical. In this manual, the author shows that the classification of Mollusks ought to

be based not alone on the form of the shell, but primarily on anatomical characters.

Dr. Fischer was *Chevalier de la Légion d'Honneur* since 1871; *Officier de l'Instruction Publique* since 1881. He had obtained several prizes at the Académie des Sciences de Paris, and had been President of the Zoological and Geological Societies of France. He possessed deep erudition, was a charming talker, and after having treated a subject belonging to the domain of natural science or of medicine, he was far from embarrassed if he had to discuss philosophy, literature or esthetics. The death of this savant who was as affable as he was modest, has been a cause for general regret and for deep mourning among his large circle of friends.—EDMOND BORDAGE.

Dr. Samuel Lockwood, of Freehold, New Jersey, Died in January, 1894, at an advanced age. Dr. Lockwood was a frequent contributor to the scientific journals, and was well-known as an enthusiastic observer. His animal biographies will always be read with pleasure. They are scattered through various periodicals, but the NATURALIST probably published the majority. Such were the History of the Mocking-bird in New Jersey; the Singing Mouse; The Pine Snake; The Coati, etc. Dr. Lockwood was, for many years, a clergyman at Keyport, N. J., and subsequently became superintendent of the public schools of Monmouth Co., N. J. His interest in education was as great as it was in scientific research. He saved many valuable specimens for scientific study, among which was the type of *Plesiosaurus lockwoodii* of the Cretaceous beds, and the bones of the huge Dinosaur, *Ornithotarsus immanis.*

Mr. Samuel N. Rhoads, of Haddonfield, New Jersey, announces that he has discovered a perfect copy (2 vols.) of the long lost "Second American Edition" of Guthrie's Geography, published in 1815. This edition is the one which contains the part on American Zoology, by the celebrated naturalist, George Ord, where, for the first time, binomial scientific names are imposed upon several species of American Mammals and Birds. The article on Zoology is Mr. Ord's private annotated copy, and is intact within the second volume. A reprint of this copy is now being prepared for publication by Mr. Rhoads, to be ready for distribution in February. The reprint will be an exact reproduction of the original, and will include also comments on the marginal annotations, which, there is no doubt, were made by Mr. Ord himself.

Science Prizes.—At the recent annual public meeting of the Academy of Sciences, Paris, M. de Lucaze-Duthiers in the chair, after some commemorative words on the deaths of Sir Richard Owen, Kummer, and DeCandolle, foreign associates, and those of Chambrélent, Admiral Paris and Charcot, members of the Academy, by the president, M. Bertrand, one of the secretaries announced the names of those to whom prizes had been awarded. It will be seen that American scientists were not forgotten.

In *Geometry*, the Prix Francoeur was awarded to M. G. Robin for mathematical physics, and the Prix Poncelet to M. G. Koenigs, for geometrical and mechanical work.

Mechanics. The extraordinary prize of 6,000 francs offered by the Department de la Marine for contrivances increasing the efficiency of the navy, was distributed among M. Bourdelles (for lighthouse illumination), M. Lephay (compass with luminous index), and M. de Fraysseix (system of optical pointing); the Prix Montyon, of 700 francs to M. Flamant (hydraulics); the Prix Plumey, of 2,500 francs, to M. Lebasteur (steam-engine appliances); the Prix Fourneyron, of 500 francs, to M. Brousset (fly-wheels).

Astronomy.—The Prix Lalande, of 540 francs, to M. Schulhof (comets); the Prix Valz of 460 francs, to N. Berberich (minor planets); the Prix Janssen, of a gold medal, to Mr. Samuel Langley (astronomical physics).

Physics.—The Prix La Case, of 10,000 Francs, to M. E. H. Amagat (gasses and liquids).

Statistics.—The Prix Montyon, of 500 francs, to Dr. Marvand (diseases of soldiers).

Chemistry.—The Prix Jecker, of 1,000 francs, to M. D. Forcrand and M. Griner in equal parts, with a special prize to M. Gautier; the Prix La Caze, of 10,000 francs, to M. Lemoine (phosphorous compounds).

Mineralogy and Geology.—The Grand Prix to M. Marcellin Boule (the central plateau of France); the Prix Bordin, of 3,000 francs, was distributed among MM. Bourgeois, Gorgen, Michel and Duboin for their researches in mineral synthesis; the Prix Delesse, of 1,400 francs, to M. Fayol (Commentry strata); the Prix Fontannes, of 2,000 francs, to M. R. Zeiller (paleontology).

Botany.—The Prix Desmazieres, of 1,600 francs, to M. C. Sauvagean (Algae); the Prix Montague to MM. Cardot (mosses) and Gaillard (Fungi).

Agriculture.—The Prix Morogues to M. Millardet (mildew).

Anatomy and Zoology.—The Prix Thore to M. Corbiere (Muscineæ)

Medicine and Surgery.—The Prix Montyon was distributed among M. M. Huchard (heart diseases), Delorme (army surgery). and Pinard and Varnier (pathological atlas); the Prix Barbier, 500 francs each to MM. Sanson (heredity) and Dr. Mauclaire (osteoarthritis; the Prix Breant, being the interest on the sum of 100,000 francs, offered for a cure for cholera, was distributed among MM. Netter and Thoinot (French cholera, 1892), and MM. Grimbert and Burlureaux (treatment of tuberculosis by creosote injections); the Prix Godard, of 1,000 francs, to Dr. Tourneux (physiological atlas); the Prix Serres, of 7,500 francs, to M. Pizon (blastogenesis), with small portions to MM. Sabatier (spermatogenesis) and Letulle (inflammation); the Prix Bellion, of 1,400 francs, to Dr. C. Chabrie (physiology of the the kidney) and Dr. Constan (fatigue); the Prix Mege to Dr. Hergott (history of obstetrics); the Prix Lallemand, of 1,800 francs, to M. Trolard (venous system).

Physiology.—The Prix Montyon, of 750 francs, to M. Lanlanie (respiration), and MM. Abelous and Langlois (renal capsules); the Prix la Caze, of 10,000 francs to M. d'Arsonval (physiological effects of electricity); the Prix Pourat to M. E. Meyer (renal secretion; the Prix Martin-Damourette, of 1,400 francs, to Dr. Gerand (albuminuria).

General Prizes.—The Arago Medal to Mr. Asaph Hall (satellite of Mars) and Mr. E. E. Barnard (Jupiter's first satellite); the Prix Montyon, for improvements in unhealthy industries, was divided between MM. Garros (porcelain manufacture) and Coquillon (fire damp meter); the Prix Tremont, of 1,100 francs, to M. Jules Morin for his useful hydrostatic and other inventions; the Prix Gegner, of 4,000 franc, to M. Serret; the Prix Petit d'Ormoz, of 10,000 francs, to M. Stieltjes (mathematics), and another of the same amount to M. Marcel Bertrand (physics of the globe); the Prix Tchihatchef, of 10,000 francs, to M. Gregoire Groum-Grschimailo (the Pamirs); the Prix Gaston Plante, of 3,000 francs, to M. Blondlot (electric interference); Mme. De Laplace's Prize, consisting of Laplace's works, to M. Bes de Berc, of the Ecole Nationale des Mines.

The sixth annual meeting of the Association of American Anatomists will take place Tuesday to Friday, May 29, to June 1, 1894, at Washington, D. C., the time and place of meeting of the Third Congress of American Physicians and Surgeons, of which this Association is a constituent part.

The Botanical Club of the American Association for the Advancement of Science at a meeting held Aug. 19, 1892, adopted these principles of Nomenclature: *Resolved:* That the Paris code of 1867 be adopted except where it conflicts with the following: I. The Law of Priority. Priority of publication is to be regarded as the fundamental principle of botanical nomenclature. II. Beginning of Botanical Nomenclature. The botanical Nomenclature of both genera and species is to begin with the publication of the first edition of Linnæus "Species Plantarum," in 1753. III. Stability of Specific Names. In the transfer of a species to a genus other than the one under which it was first published the original specific name is to be retained, unless it is identical with the generic name or with a specific name previously used in that genus. IV. Homonyms. The publication of a generic name or a binominal invalidates the use of the same name for any subquently published genus or species respectively. V. Publication of Genera. Publication of a genus consists only (1) in the distribution of a printed description of the genus named. (2) in the publication of the name of the genus and the citation of one or more previously published species as examples or types of the genus, with or without a diagnosis. VI. Publication of Species. Publication of a species consists only (1) in the distribution of a printed description of the species named, (2) in the publishing of a binominal, with reference to a previously published species as a type. VII. Similar Generic Names. Similar generic names are not to be rejected on account of slight differences, except in the spelling of the same word; for example *Apios* and *Apium* are to be retained, but of *Epidendrum* and *Epidendron*, *Asetrocarpus* and *Astrocarpus*, the later is to be rejected VIII. Citation of Authorities. In the case of a species which has been transferred from one genus to another the original author must always be cited in parenthesis, followed by the author of the new binominal. N. L. Britton, John M. Coulter, Henry H. Rusby, William A. Kellerman, Frederick V. Coville, Lucien M. Underwood, Lester F. Ward, *Committee.*

At the meeting of the New York Academy of Sciences to be held on March 5th prox., will be held a debate between the supporters of the Neodarwinian and Neolamarckian theories of organic evolution. Prof. E. S. Poulton, of the University of Oxford, England, will open for the former, and Prof. E. D. Cope, of Philadelphia, will reply for the latter. Profs. W. B. Scott, of Princeton, and E. B. Wilson of New York, will also speak.

Prof. W. P. Wilson has brought to Philadelphia twenty-four car loads of exhibits, mostly of natural objects, which were displayed at the Chicago Exposition.

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Pueblos and Cliff Dwellers. by J. Walter Fewkes, of the Hemingway Expedition, Mr. A. M. Stephens, of Keam's Canon, and others. Also on the "Characteristics of the American Languages," by Dr. D. G. Brinton, Prof. Ed. Seler and others. Also on the Myths and Folklore, by Mr. James Deans and the Rev. John McLean. Mr. A. Perry, of London, England, Mrs Zelia Nuttall and G. A. Dorsey will write upon Mexican and Peruvian Antiquities. There will be articles on the ASIATIC or POLYNESIAN ORIGIN of the American Indians, and on Prehistoric Contact with Other Continents, by Dr. Cyrus Thomas, Hon. James Wickersham and C. Staniland Wake and on certain "Bronze, Copper and Rare Stone Relics" which have recently come to light, by Dr. J. D. Butler, J. R. Sutter, H. I. Smith, William R. Seever, and S. H. Montgomery. Notes on

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The Microscope and Its Accessories. (Illustrated.) The Editor.
A Device to take the place of the Camera Lucida in Micrography. (Illustrated.) H. G. Piffard, M. D.
A Midwinter Month by the Mediterranean. G. H. Bryan, M. A.
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AMERICAN NATURALIST

VOL. XXVIII. April, 1894. 328

WHENCE CAME THE CULTIVATED STRAWBERRY?

By L. H. Bailey.[1]

The strawberry has been extensively cultivated only during the last century, and the earliest attempt at methodical amelioration extends back little more than two hundred years. The first horticultural variety of which we have any account is the Fressant, which dates from 1660. The wild species of strawberries are few, not numbering more than a dozen under the most liberal estimate, and they are well represented in the great herbaria or botanical centers of the world. Only a part of the wild types have been impressed into cultivation, and exact or very approximates dates can be given for the introduction of these cultivated species.

The strawberry, therefore, is a modern fruit, and its history and evolution would seem to possess no difficulties; and yet, despite all these facts, the botanical origin of the cultivated varieties is unknown, and we have the anomaly of a common fruit, appearing within little more than a century, which the botanist does not refer to any species. Here, then, is a most remarkable instance of the evolution of a new type of plant, taking place under our very eyes: whilst the botanists have written precise histories of its successive progresses, the reasons and methods of its development have escaped them. Perhaps there is no other plant which has so quickly obscured its own

[1]Lecture before the Author's class in Horticulture, Cornell Univ., Ithaca, New York.

origin, or in which the speculative evolutionist can find stronger proof of the instability and elasticity of plants.

I have said that the history of the strawberry is well known. There has been a careful record from the time Casper Bauhin and his contemporaries wrote their voluminous herbals. We cannot expect, as this time, therefore, to add anything to this long and consequential record. We must accept the history essentially as we find it. But it is possible that we shall be able to elucidate the evolution of the strawberry by the application of some of the principles of plant variation, the knowledge of which is now sufficient to warrant a constructive retrospect. At all events, if these laws cannot solve the general problem of the evolution of the strawberry, we must continue to remain in ignorance of its birth and departure. This inquiry will be all the more interesting, also, from the fact that the first monographer of the strawberries, Duchesne, in 1766, made an attempt to explain the origin of known species from the Alpine or Everbearing strawberries of Europe, and this essay, which has apparently not attracted the attention of modern philosophers, is one of the earliest efforts to account for the origin of organisms by means of a course of development.

It is necessary at the outset to eliminate the so-called European types of strawberries from our inquiry. These belong to three or four species native to Europe, chiefly to *Fragaria vesca* and *F. moschata* (*F. elatior*), and the botanical characters are sufficiently clear and uniform to allow of little doubt as to their origin. The first strawberries, like the Fressant, are of this type. These European types are mostly small and delicate fruits which are grown in France and some other parts of continental Europe, but which are little more than curiosities in England and America. It is the class of large American and English strawberries to which I now wish to direct attention, a type which, while grown in all temperate countries, seems to have first come to great prominence in England and which is the only market strawberry of America.

The first foreign strawberry to reach Europe was the common small species of eastern America, and which is known to

botanists as *Fragaria Virginiana.* The first distinct record of it in Europe is in 1624, when it was mentioned by Jean and Vespasien Robin, gardeners to Louis XIII. For more than a century it appears not to have taken on any new or striking forms. It bore a small bright scarlet berry, with a distinct constriction or neck near the stem and slightly acid flesh. It was in no way very different, probably, from the common wild strawberry which we now pick in the fields. It was never greatly esteemed on the continent, but in England it found greater favor. Duchesne writes of it, in 1766, that "they still cultivate it in England with favor" (avec honneur). The original form of the Scarlet or Virginian strawberry was still highly esteemed in England less than three-quarters of a century ago, at which time Barnet[2] wrote enthusiastically of it. "This," [the Old Scarlet Strawberry] he says, "which has been an inhabitant of our gardens nearly, if not fully, two hundred years, was doubtless an original introduction from North America. It is singular that a kind of so much excellence, as to be at present scarcely surpassed by any of its class, should have been the first known. It continued in cultivation considerably more than half of the period of its existence as a garden fruit, without any variety having been produced of it, either by seed or by importation from America." Yet Barnet knew twenty-six good varieties of the species and describes them at length; and four of them seem to have come directly from America, probably from wild plants. A considerable progress had been made in the amelioration of the strawberry in England at the opening of the century, therefore, from the Virginian stock or foundation; but the varieties were much alike and contain little promise of the wonderful development in the strawberry varieties which we now enjoy.

About 1712, a second species of strawberry reached Europe. This is the *Fragaria Chiloensis*, brought from Chili to Marseilles by Capt. Frezier. It reached England in 1727. It is a stout, thick-leaved shaggy plant which bore a large globular or somewhat pointed late dark colored fruit. In a few places, particularly about Brest, in France, it came to be cultivated

[2] Trans. London Hort. Soc., vi, 152 (1824).

for its fruit; but in general it met small favor, particularly as the flowers were often imperfect and it did not fertilize itself. It did not seem to vary much under cultivation; at least, when Barnet wrote, about a century later, he knew only three varieties in England which he could refer to it, one of which he considered to be identical with the original plant as introduced by Frezier. The Chilian strawberry grows along the Pacific coast in both North and South America, and it has been introduced into our eastern gardens several times from wild sources; but it always soon disappears. There is little in the record of this species, therefore, of promise to the American horticulturist.

In the middle of the last century, a third strawberry appeared in Europe. Some writers place the date of its introduction with considerable exactness; but the fact is that no one knew just when or how it came. Phillip Miller described and figured it in 1760 as the Pine strawberry, in allusion to the pine-apple fragrance of its fruit. There were three opinions as to its origin at that time, some saying it came from Louisiana, others that it came from Virginia, while there was a report, originating in Holland, that it came from Surinam, which is now the coast of Dutch Guiana. None of these reports have been either confirmed or disproved, although Gay, in making extensive studies of the growth of strawberries, may be said to have effectually overturned the Surinam hypothesis in his remark that to find a strawberry growing at sea-level within five degrees of the equator, is like finding a palm in Iceland or Hammerfest![3] Duchesne, in his Natural History of Strawberries,[4] 1766, described a Pine-apple strawberry as *Fragaria ananassa*, and while he did not know its origin he argued that it must be a hybrid between the Chilian and Virginian species. The pine-apple strawberries of England and France were found to be different from each other upon comparison, although the differences were such as might arise within the limits of any species or type, and by the end of the century most botanists began to regard the two as

[3]Ann. Sci. Nat. 4th Ser. viii, 203 (1857).

[4]Histoire Naturelle des Fraisiers. Par M. Duchesne fils. Paris, 1766.

variations of one stock. This general type of Pine strawberries, comprising the large-hulled type long represented by the Bath Scarlet and erected into a distinct species by Duchesne as *Fragaria calyculata*, has been collectively known for a century as *Fragaria grandiflora*, a name bestowed by Ehrhart in 1792, although this name, together with the English name Pine, is gradually passing from use. We may say that thus far there are three hypotheses as to the origin of the Pine strawberry—that it came from North America, from Guiana, and that it is a compound or hybrid of two other species; and we may add a fourth—that apparently accepted by Duhamel and DeCandolle and certainly by Gay—that it is a direct modification of the Chilian strawberry, and also a fifth, advanced by Decaisne[5] and accepted by others, that some, at least, of the varieties are products of the large, robust native form of our wild strawberry which is known as *Fragaria Virginiana* var. *Illinoensis*. I shall drop the Guianian origin as wholly untenable, and it will also be unprofitable to discuss directly the question of importation from North America, for we have nothing more than conjecture upon which to found any historical argument. I shall now endeavor to discover which of the remaining three hypotheses is best supported in the subsequent evolution of the plant itself: Is it a hybrid, a direct development of the Chilian species, or a form of the native variety *Illinoensis?*

It is first necessary, however, to determine from what ancestral type our cultivated strawberry flora has sprung. Barnet, writing in 1824, referred all cultivated strawberries to seven groups or classes, three of which comprise the small European varieties which are outside this discussion. The remaining four classes comprise all the large-fruited types, and they are as follows: 1. The Scarlet or Virginian strawberries, with twenty-six varieties; 2. The Black strawberries or *Fragaria tincta* of Duchesne, with five varieties; 3. The Pines, with fifteen; 4. The True Chili strawberries, with three varieties. The Blacks and Pines are so nearly alike that they can be classed as one. Although the Pine class is the most recent of the lot, it had already varied into twenty forms, and, moreover,

[5] Jardin Fruitier du Museum, ix, under "Frasier d'Asa Gray."

it contained the choice of the varieties. In this class is Keen's Seedling, which was then coming into prominence. This variety is the first conspicuous and signal contribution to commercial strawberry culture, and it marks an epoch amongst strawberries similar to that made by the Isabella amongst American grapes. It was grown from seeds of Keen's Imperial, which, in turn was raised from the White Carolina (known also as Large White Chili), which is regarded by Barnet as a Pine strawberry. Thomas Andrew Knight had made various interesting and successful crosses amongst the Scarlet or Virginian strawberries, but Keen's varieties so far excelled them, that Knight's productions were soon lost. From Keen's Seedling the present English strawberries have largely descended. The fruit of this remarkable strawberry was first shown in London in 1821. At this time there were apparently no important varieties in this country of American origin. Prince,[6] writing in 1828, enumerates thirty strawberries of American gardens, of which all, or all but one, are of foreign origin. The two important varieties, and the ones which supplied "the principal bulk of this fruit sold in the New York market" were Red Chili (referred by Barnet and by George Lindley[7] to the Pines) and Early Hudson, probably a variety of *Fragaria Virginiana.* Keen's berries are in the list, but these, according to Hovey and other later writers, did not thrive in America. As late as 1837, Hovey wrote[8] that "as yet the plants of nearly all the kinds in cultivation have been introduced from the English gardens, and are not suited to the severity of our climate." Mr. Hovey resolved to produce an American strawberry, and with a shrewdness which has rarely been equalled in the breeding of plants, he selected parents representing distinct ideals and the best adaptations to American conditions. Four varieties entered into a certain batch of crosses which he made. These were Keen's Seedling and Mulberry, both Pines, Melon, probably a Pine, and Methven Scarlet, a variety of the Virginian. From these crosses, two

[6]A Short Treatise on Horticulture, 72. New York.

[7]A Guide to the Orchard and Kitchen Garden, 487. London, 1831.

[8]Mag. Hort. iii, 246.

varieties were obtained,[9] one of which fruited in 1836. These were the Hovey and Boston Pine. Owing to the loss of labels, it is not certain which crosses gave these varieties, but Mr. Hovey was always confident that the Hovey sprung from Mulberry crossed by Keen's Seedling. The Hovey strawberry revolutionized strawberry growing in this country. It was to America what Keen's Seedling was to England; and it marks the second epoch in commercial strawberry culture. American varieties now appeared from year to year, and the greater part of them have come directly or indirectly from the Hovey and the Boston Pine. With the passing out of the Boston Pine and its immediate offspring, the term Pine has practically been lost to American strawberry literature, and the word is but a memory in the minds of the older men; but this is not because the class itself has disappeared, but, on the contrary, because it has become the dominant class and has driven out the Scarlet and all other competitors. The Hovey was a true Pine strawberry. Mr. Hovey grew it in his garden till the last, and it was my good fortune to secure a few plants of him shortly before his death. A plant is now before me as I write, and it has all the marks of the old Pine or Grandiflora type—the thick rounded dark leaves, stocky habit, stiff flower cluster, and large spreading calyx. All our commercial strawberries are Pines, and they compare well in botanical characters with the *Fragaria grandiflora* of the French gardens of a half century ago and with the famous Bath Scarlet and Pitmaston Black which were important Pines when Barnet wrote, specimens of all of which I have before me.

Our strawberries, then, are lineal descendents of the old Pine class, known to botanists as *Fragaria ananassa* and *F. grandiflora*. Now the question recurs, what is the Pine? where did it come from? how did it originate? Three hypotheses, as I have said, have been advanced which an evolutionary review of the subject is capable of considering. Is it (1) a hybrid? (2) a direct development of the Chilian strawberry? or (3) a modified form of our big wild strawberry, *Fragaria Virginiana* var. *Illinoensis?*

[9]Mag. Hort. vi, 284 (1840). Fruits of America, i, 25, 27.

1. Is the Pine a hybrid? The only reason ever advanced for considering the Pine strawberry to be a hybrid was the supposed impossibility of accounting for its attributes upon any other hypothesis. The ideas of hybridity were indefinite in those times, and intermediateness of characters was often supposed to be enough—as it is, unfortunately, too often at the present day—to establish a hybrid origin. In considering this matter, two questions at once arise: (a) Does the Pine bear evidence of being a hybrid? (b) Would hybrid characters perpetuate themselves? I am wholly unable to find, either in herbarium specimens of the plants themselves or in the pictures of the plants, any distinct evidences of hybridity. The Pine strawberries differ from the Chilian chiefly in their greater size, less hairiness and better fruit, and sometimes by somewhat thinner leaves, although this thinness of foliage is usually more apparent than real, being due to the larger size and consequently greater flexibility of the leaf without any real diminution in substance; and I have seen as thin leaves in wild *Fragaria Chiloensis* as in garden berries. But greater size could scarcely be obtained from the smaller or or least more slender Virginian strawberry, and better sweet fruit would not likely result from the amalgamation of the Chilian with the little acid fruit of the other. On the other hand, there is not a character of the Virginian, so far as I know—save possibly some thinness of leaf—which appears in the Pine. The slender erect habit, smooth stems, profusion of early runners, comparatively simple and very weak-rayed trusses, the small calyx, the early, light-colored pitted fruit—none of these marks of the Virginian strawberry appear in the Pine. Again (b), it is now known that one of the most characteristic marks of hybrids is their variability when propagated from seeds; and yet Phillip Miller declares that the old Pine strawberry came true to seed! A hybrid left to itself almost invariably departs from its mongrel type and reverts to one or the other parent; and yet here is a supposed hybrid which has held its attributes intact for one hundred and fifty years, and has presented a sufficiently unbroken front to overcome all competi-

tors.[10] There is not only no evidence in favor of a hybrid origin, but there is very much against it; and I have no hesitation in discarding the hypothesis in favor of a simpler and more philosophical one.

2. Is the Pine strawberry a direct development of the Chili strawberry? Every feature of the Pine strawberry suggests the Chilian species. It differs chiefly in its greater size and sometimes by a slight loss of hairiness, but the relative sizes of the parts remain much the same as in the wild type. It is now well known that variation induced by changed conditions of life and augmented by subsequent selection, is the common and potent means of the evolution and amelioration of plants. Hybridization rarely effects a permanent evolution of types. To suppose that the Chilian strawberry should have varied into the type of the common strawberry is in accord with all the methods of nature. But there are two considerations which convince me beyond all question that cultivated strawberries belong to *Fragaria Chiloensis*: (a) Their botanical characters, which I shall discuss more fully in the next paragraph, (3), and (b) direct experiment. The experiment which I now record I consider to be of great importance. In 1890, I sent to Oregon for wild plants of *Fragaria Chiloensis.* The strawberries which I secured were short, stocky, thick-leaved, hairy, evergreen plants, at once distinguishable from the garden sorts. They were planted in a spot convenient for observation. I pressed one of the original plants and have taken specimens from time to time since. A specimen taken in May, 1891, is scarcely distinguishable from the wild plants set the year before, but specimens secured in July of the same year, show the longer stalkes and larger leaves of garden strawberries; while an average specimen taken in June, 1892, is indistinguishable from common cultivated varieties in botanical features! Here, then, is a change in two years, and not by seeds, either, but in the same original plants or their offshoots. This change, while remarkable, is still not unintelligible, for I have seen many cases of as great modification in plants

[10] For a general discussion of the theory of hybridity, consult Bailey, Cross-Breeding and Hybridizing, 1892.

under cultivation; and the Chilian strawberry is widely variable in its wild state. Barnet has inadvertently recorded a distinct departure from the type of the Chilian plant, for he says that while this strawberry usually loses its leaves in winter, the varieties which have been bred from it keep their leaves. This change in my plants is due primarily, no doubt, to a greater amount of food, arising from the greater space which the plants are allowed to occupy; and it is possible that other environments may have assisted in the transformation. Having this experimental evidence, which so forcibly supplements direct botanical evidence and so well emphasizes the known laws of plant variation, I can no longer doubt that the garden strawberries are *Fragaria Chiloensis*, that the early botanists did not recognize the garden type as a departure from this species, and that this type has finally driven from cultivation the forms of *Fragaria Virginiana*. And I am glad to know that so great an authority as the elder DeCandolle accepted the opinion of Seringe (1825) that the Pine, Bath Scarlet and Black strawberries belong to the Chilian species, for the Prodromus makes Duchesne's *Fragaria ananassa*, *F. calyculata* and *F. tincta* all varieties of the Chilian plant. This was evidently the opinion of the Dutch plantsmen of the middle of the last century, also, for even before Duchesne described the Pine strawberry, these merchants sold it under the name of *Fragaria Chiloensis ananæformis*, indicating that it was regarded as a form of the Chilian species. And Duhamel, towards the close of the last century, said that the Pine could be raised from seeds of the Chilian. It is evident, however, that Seringe did not mean to say that all the large garden strawberries are offshoots of the Chilian species, for he has a variety *hybrida* of *Fragaria Virginiana*, which is a supposed compound of this species and the Pine. But if there was any hybridization in the early days, I am confident that it was only incidental and its effect was transitory. Our present strawberries are apparently direct and legitimate progeny of the Chilian species.

3. Is the Pine strawberry derived from *Fragaria Virginiana* var. *Illinoensis?* I confess that I have believed until recently that the garden strawberries are offspring of our native berry;

certainly I have always hoped that such would prove to be their origin. It is with much reluctance that I give up a pleasant and patriotic hypothesis; but everything is against it. I had long thought that the Pine strawberry of last century was only this robust form of our native species, a feeling to which the early conjectures of an American origin for the Pine lent color. But the Pine and the var. *Illinoensis* are so unlike in habit that they could not have been confounded. When the var. *Illinoensis* was really introduced into Europe in 1852 by Asa Gray, who secured it from the "wild and savage" country in western New York, it was thought to be so distinct from all other strawberries that it was made a new species, *Fragaria Grayana,* although it is scarcely different, except in greater size, from the common *Fragaria Virginiana.* If this plant possessed such eminent and variable qualities as to have made it the parent of our garden varieties, it would certainly have given indications of them somewhere in its wide and varied range. As it is, it has only now and then come into cultivation, when its behavior has been such that it has soon been discarded, as in the well known instance of the recent Crystal City. I have also tried to cultivate it, and its response, like the Crystal City, is mostly in leaves and runners, not in any permanent or striking modification. It is true that the botanical features of the garden strawberries and the var. *Illinoensis* are much alike, particularly in herbarium specimens, and for some time I was not able to separate them readily; but there are botanical characters, even aside from habit, which distinguish them. The garden strawberries are lower in habit, producing runners freely only after fruiting, with shorter petioles and more leaves springing from the crown of the plant, and the leaves are spreading—all of which are striking peculiarities of the Chilian plant,—while in the native plant the leaves stand up on long nearly perpendicular stalks and the runners are produced at flowering time; the leaflets are thick and firm in texture, broader than in *Illinoensis* and lacking the long narrow base of the native, with mostly rounder teeth, and they are particularly distinguished by the dark upper surface and the bluish-white under surface of the mature leaflets, the

color of the leaflets in the native plant being light lively green, with little difference between the two surfaces. In these points of difference, too, the garden berries are characteristically like the Chilian. The truss or inflorescence is different in the two. In the garden berries, the truss stands more or less oblique or is often prostrate, and it is broken up into two or three strong, often unequal spreading arms from which the short and stout fruit-stems spring, and this is the distinctive habit of the Chilian species; in the *Illinoensis*, the truss is erect and it breaks up more regularly at its top and the inflorescence is less strongly spreading in proportion to the number of fruits it contains, and the fruit-stems are weak and slender and more or less drooping. The calyx is very large in the garden berries, a fact which Duchesne recorded in the name *Fragaria calyculata* which he applied to the large-hulled forms like the old Bath Scarlet, of which many are in cultivation at the present time. The fruit in *Illinoensis* is small and soft and bright scarlet, usually with a distinct neck and deeply embedded seeds; that of the garden berries still maintains the features of the Chilian berry in its large size, mostly globular-pointed form, dark color and seeds borne more nearly upon the surface. The garden berries are in every way much farther removed from the native berry than they are from the Chilian. From the latter they differ most widely, as I have said, in the taller growth and less hairiness;[11] but even in these features they do not resemble very closely the *Illinoensis*. It may be urged that all these differences might have come about under the influence of cultivation if *Illinoensis* itself had been the parent of the garden forms, to which I reply that direct experiment does not sustain the assumption, and that the excellent engravings of the early forms of the Pine strawberry show the same differences. It was the study of these pictures which first led me seriously to doubt the East-American origin

[11] It is often said that the fruit of the Chilian strawberry is erect and that the garden berries differ in a nodding fruit, but this is an error. While the fruit stems of the true Chilian are stiff, I have never known them to be erect, and in wild plants which I have grown, the fruit has the same drooping habit as in the garden berries. The Chilian species probably varies naturally in its fruiting habit, but I have yet to find an instance in which it holds its fruit upright.

of our strawberries. No one can examine the excellent colored pictures of Keen's berries,[12] and other early varieties, without being struck by the thick blue-bottomed leaves and wide-spreading arm-like trusses—indisputable marks of *Fragaria Chiloensis.*

Yet, despite these important botanical differences, the garden berries and the native *Illinoensis* are much alike, as I have said; and this similarity is really one of the arguments in support of a different geographical origin of the two. Similar climates or environments produce similar results, and when old berry fields are allowed to run wild, the plants do not revert to the type of the Chilian species, but are modified rather more in the direction of the indigenous plant. In the fall, when the flower trusses are gone and growth has ceased, it is sometimes almost impossible to distinguish between the leaves of spontaneous garden berries and wild *Illinoensis;* but the flower clusters the following spring will be likely to distinguish the two. As a matter of fact, garden berries probably do not often persist long when run wild. They are unable to contend with the grass and weeds, although *Illinoensis* may find in similar circumstances an acceptable foothold. It is not strange, therefore, that those individuals from the old cultivated beds which longest persist should be those nearest like the native berries, for such would fit most perfectly into the feral conditions.

There is only one conclusion, therefore, which fully satsifies all the demands of history, philosophy, and botanical evidence, and this is that the garden strawberries are a direct modification of the Chili strawberry. The initial variation occurred when species were thought to be more or less immutable, and, lacking exact historical evidence of introduction from a foreign country, hybridization was the most natural explanation of the appearance of the strange type. This modified type has driven from cultivation the Virginian berries which were earlier introduced into gardens; and the original type of the Chilian strawberry is little known, as it tends to quickly dis-

[12]See, for instance, the plate of Keen's Seedling in Trans. London Hort. Soc., v 261.

appear through variation when impressed into cultivation. The strawberry is an instance of the evolution of a type of plant in less than fifty years, which is so distinct from all others that three species have been erected upon it, which was uniformly kept distinct from other species by the botanists who had occasion to know it best, and which appears to have been rarely specifically associated with the species from which it sprung.

THE PARASITIC PROTOZOA FOUND IN CANCEROUS DISEASES.

By Alice Bodington.

In the British Medical Journal for Feb. 26th, 1893, the "steady increase of cancer" is spoken of as a subject requiring serious attention, and as far back as 1887–8, the Council of the Association drew the attention of the Registrar-General to the "steady increase in the deaths from cancer," out of proportion to the deaths from all causes, and showed *that similar conditions exist in most civilized countries.* The "increasing mortality from this terrible disease, not merely kills nearly twenty thousand persons in England and Wales alone" [the southern part of one small island!] but kills the vast majority of them by slow and cruel torture continued during a long series of months, sometimes of years." Cancer, like insanity, seems specially to find in the highest conditions of civilization a hot bed in which it flourishes and spreads; and any clue which can guide civilized man to the secret of grappling successfully with this hitherto unconquerable foe, will be one of the greatest boons which science can confer upon mankind. To know where the enemy lurks, and in what form, is, in the case of parasitic diseases, not only half but sometimes all the battle; as the almost complete immunity from cholera of England has shown.

An army of keen observers has endeavoured for many years past to discover, if possible, the exciting cause of cancer, but till lately the prospect of discovering the foe appeared hopeless. The theory which seemed most firmly established, most consonant with scientific theory, was at the same time a singularly hopeless one. It was assumed that at the decline of life, or under conditions of lowered vitality in the whole or part of the body, certain embryonic structures—especially of the kind known as "survivals"—took on an abnormal growth, and rioted in the production of epithelial cells of a low type which

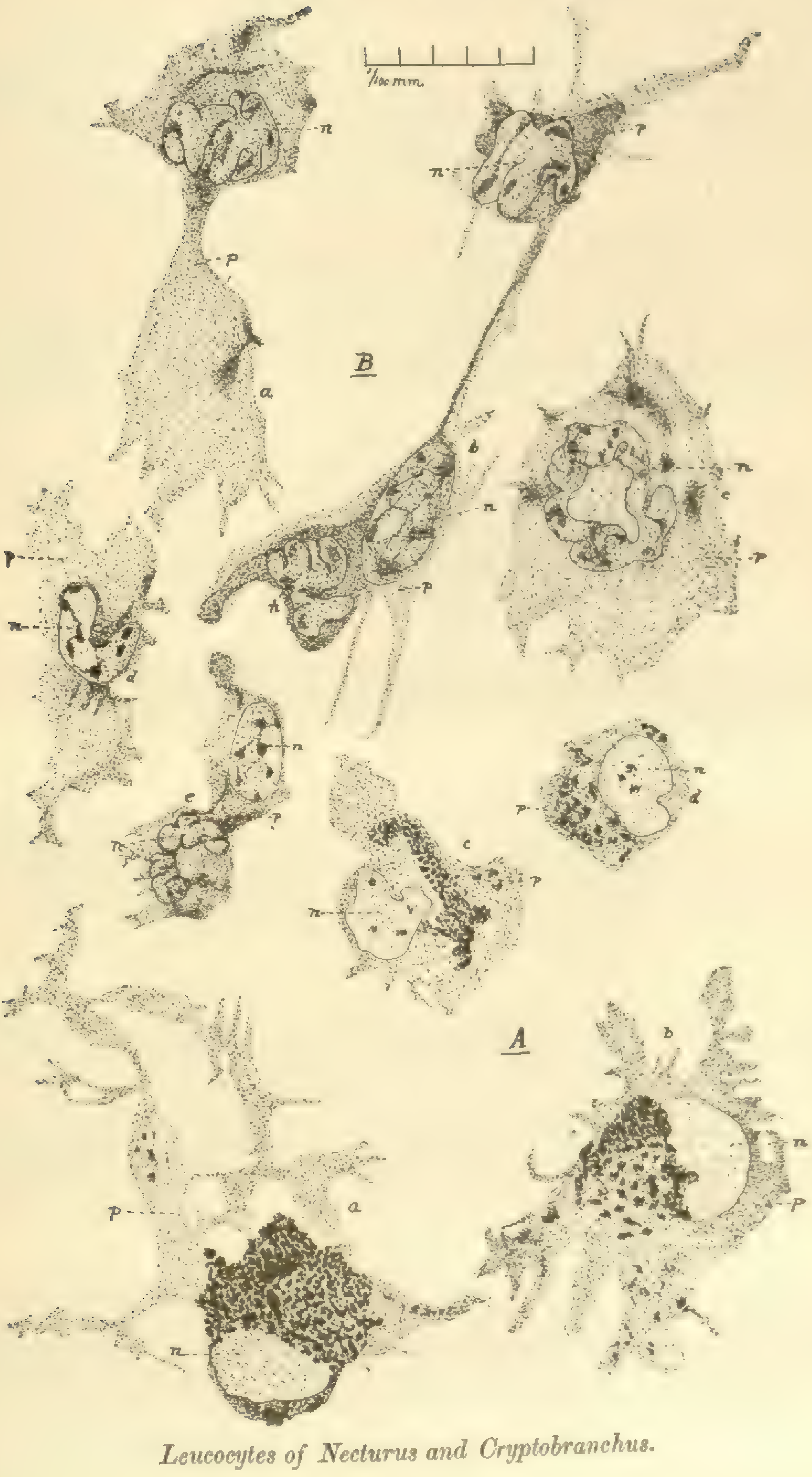
flourished at the expense of the healthy structures round them. Now any disease arising from degeneration or overgrowth of embryonic survivals, [such as the remains of the Wolffian duct in the female] sets at defiance all human precautions; the embryonic tissue is hidden, and no one can tell either when or why it begins to go wrong. If cancer owed its rise simply and solely to an overgrowth of embryonic tissue, there was no hope but in an early, a thorough, an unsparing use of the knife; no *stamping out* of the disease could be hoped for or thought of. All attempts to trace the disease to the action of bacteria failed. But during the last few months the patient, cautious, untiring labour of years of a number of distinguished pathologists has enabled them to detect the existence of organisms in cancer, which resemble, in all that is known as yet of their life history, the Sporozoa; and more especially the *Coccidium oviforme.* (Leuckart), of the rabbit.

Fig. 1.—*a*, Coccidium showing capsule full of granular protoplasm; *b* shows condensation of the protoplasm into one sphere, after two days' growth external to body; *c*, division of the single sphere into four daughter spherules, after four days' development; *d*, an empty ruptured cyst. (From photographs x about 500.)

The whole life cycle of *Coccidium oviforme* is now known; its discovery has been the work of more than thirty years, so that there is no reason for discouragement if some stages of the life history of the Coccidium found in cancer still elude research.

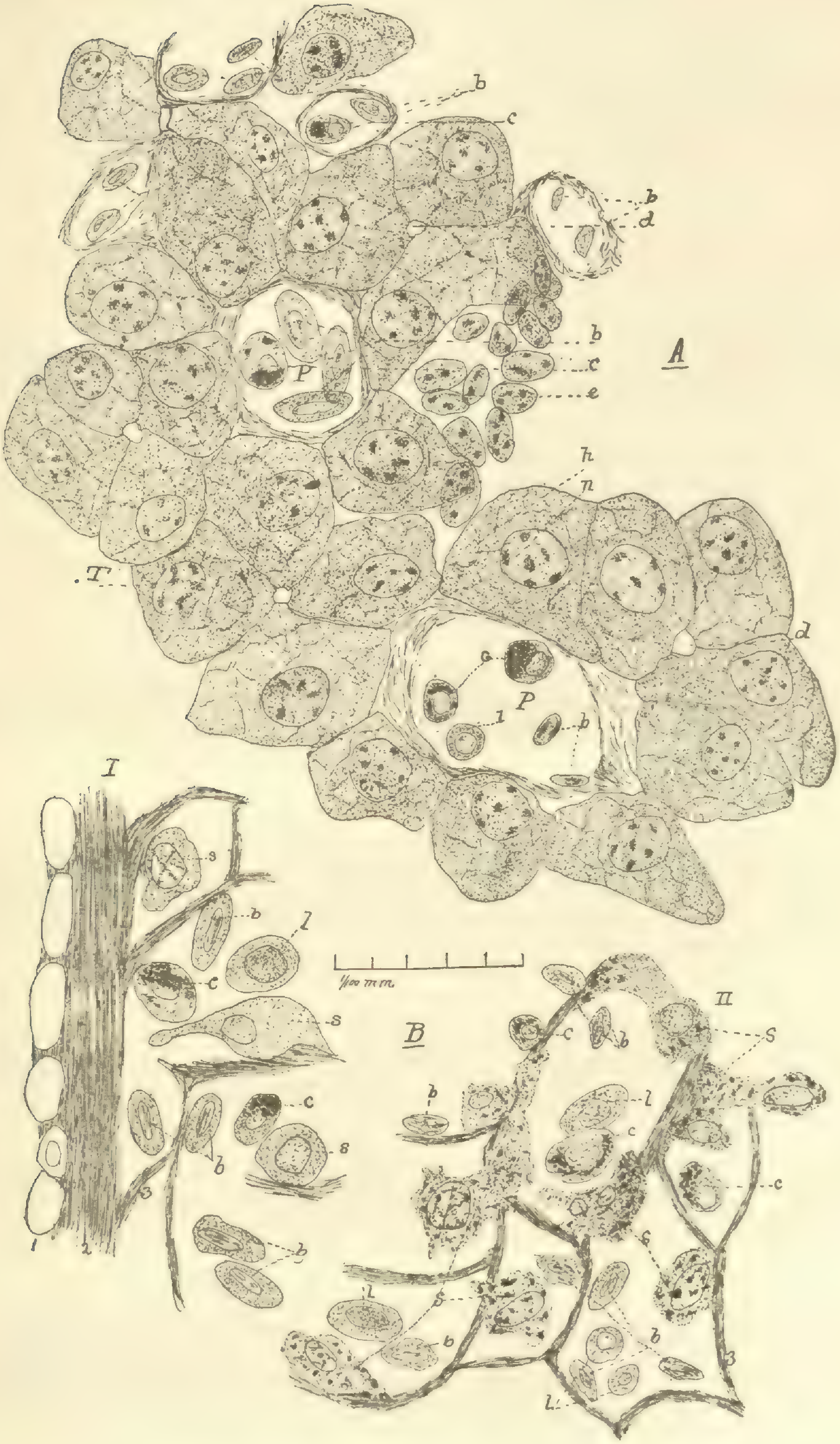
Dr. Galloway after describing the symptoms of coccidian infection in the rabbit, begins with the life of the protozöon after it leaves the body. "The organism" he says "as it escapes from the alimentary canal consists of a firm translu-

PLATE IV.



Leucocytes of Necturus and Cryptobranchus.

PLATE V.



Sections of Liver and Spleen of Cryptobranchus.

cent cyst oval in shape [see Fig. 1, *a*] enclosing a quantity of very granular protoplasm which fills the whole body. Very

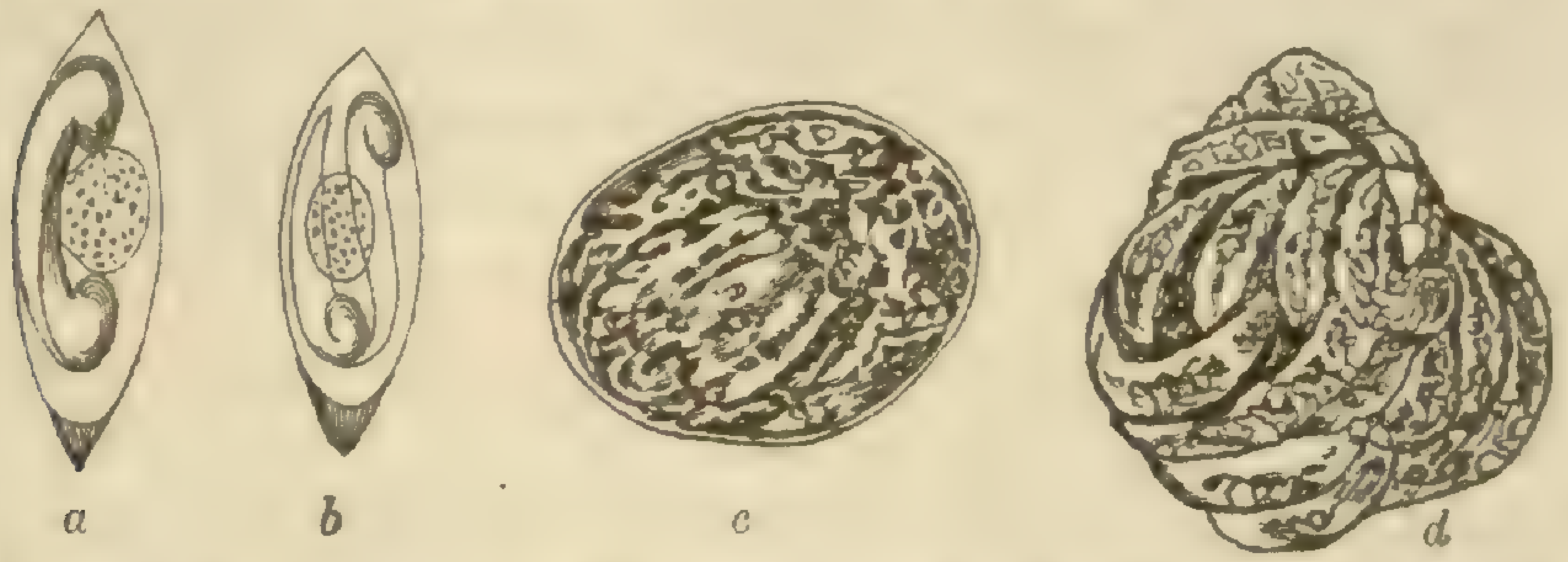


Fig. 2—Stages in Life History of *Coccidium oviforme*. *a*, *b*. Formation of crescentic spores within the daughter spherules external to the host (after Balbiani); *c*, *d*, sporulation within the host, division of the spores into numerous crescentic segments. (After photographs by Pfeiffer x 1,000.) From 'Morton Lectures,' by James Galloway, A. M.; M. D. Aberdeen. British Medical Journal. Feb. 4th, 1893.

soon after expulsion, and often while within the host, the protoplasmic contents contract [Fig. 1, *b*] and form a sphere lying free within the cell wall. Under suitable circumstances, this ball of protoplasm sends out projections and at length divides into four distinct smaller spherules [Fig. 1, *c*.]" These four spherules are "transformed[1] into four spores provided with a very resistant external covering. Each spore encloses two falciform and very delicate embryos, [Fig. 2.] which give birth to new parasites, and thus engender the terrible disease when swallowed in polluted food. The sporiferous coccidia penetrate into the digestive canal of rabbits, and the envelope of the spore protects the falciform embryos against the action of the gastric juice. So strong is the protecting capsule that the spores can live for at least six months outside the body [Galloway]. The epithelial cells of the small intestine and of the biliary ducts are the seat of the internal activity of the parasite, on reaching which a "new cycle of intense activity is observed. The falciform young take on a rounded shape, and probably acquire the power of locomotion. Most of the naked amœboid forms of the organism divide into small crescentic

[1] Carcinomata and Coccidia, Elias Metschnikoff, M. D. Chef de Service, Institut Pasteur. Revue Générale des Sciences Pures et Appliquées. Brit. Medical Journal. Dec. 10th, 1892.

sporules, which, in their turn, also become free, and myriads of young sporozoa are soon formed. These possess the "power of insinuating themselves into the protoplasm of epithelial cells, where they grow and become transformed into oval parasites resembling the adult form" [Metschnikoff]. In course of time, the epithelial cell wall is ruptured and the parasite escapes, without necessarily causing the destruction of the pest cell; it passes through the alimentary canal, gains access to the atmosphere, and thus attains the conditions necessary to recommencing its cycle of development. Having been shown the life history of the coccidian parasite of the rabbit,[2] we shall be better prepared to recognize the [apparently] kindred disease in man and some of the higher vertebrates. "Taking cancer of the breast as an example," says Dr. Galloway, "if careful microscopic examination is made, there will be found lying, most commonly within the cell body, rounded or oval structures varying in most cases from 2 μ to 10 μ in diameter, having, when large, a very distinct capsule, and containing a smaller body of variable shape. From the capsule there may be seen passing towards the centre numerous fine radial striations, ... and processes of a somewhat different character may also be seen passing from the nucleus towards the periphery; they are not so regular and appear to be prolongations of the nucleus.

"These bodies occur sometimes singly, sometimes in twos and threes, and occasionally to the number of nine or ten—and even twenty,[3] of small size—in a single cell. In a successful preparation each of the small ones will be seen to contain the usual nuclear substance (see Figs. 3 and 4). Similar structures of smaller size may be observed lying *inside the nucleus* of the epithelial cells. In this ease the capsule, so very characteristic of the intracellular bodies, is very slight, and indeed, appears to be absent in most cases. "The intra-nuclear bodies also occur either singly or in small groups." Occasionally the

[2] See also Fig. XVII, Sporozoa; *Gregarinidæ* article Protozoa, Encyclopedia Britannica, pp. 852–3.

[3] "I have seen over 20 parasites in the same nucleus."—M. Armand Ruffer, M. D., *B. Medical Journal*, Nov. 5, 1892.

FIG. 3.

Cells from different cancers of the breast, showing various forms of parasites in the cell protoplasm × 1,200.

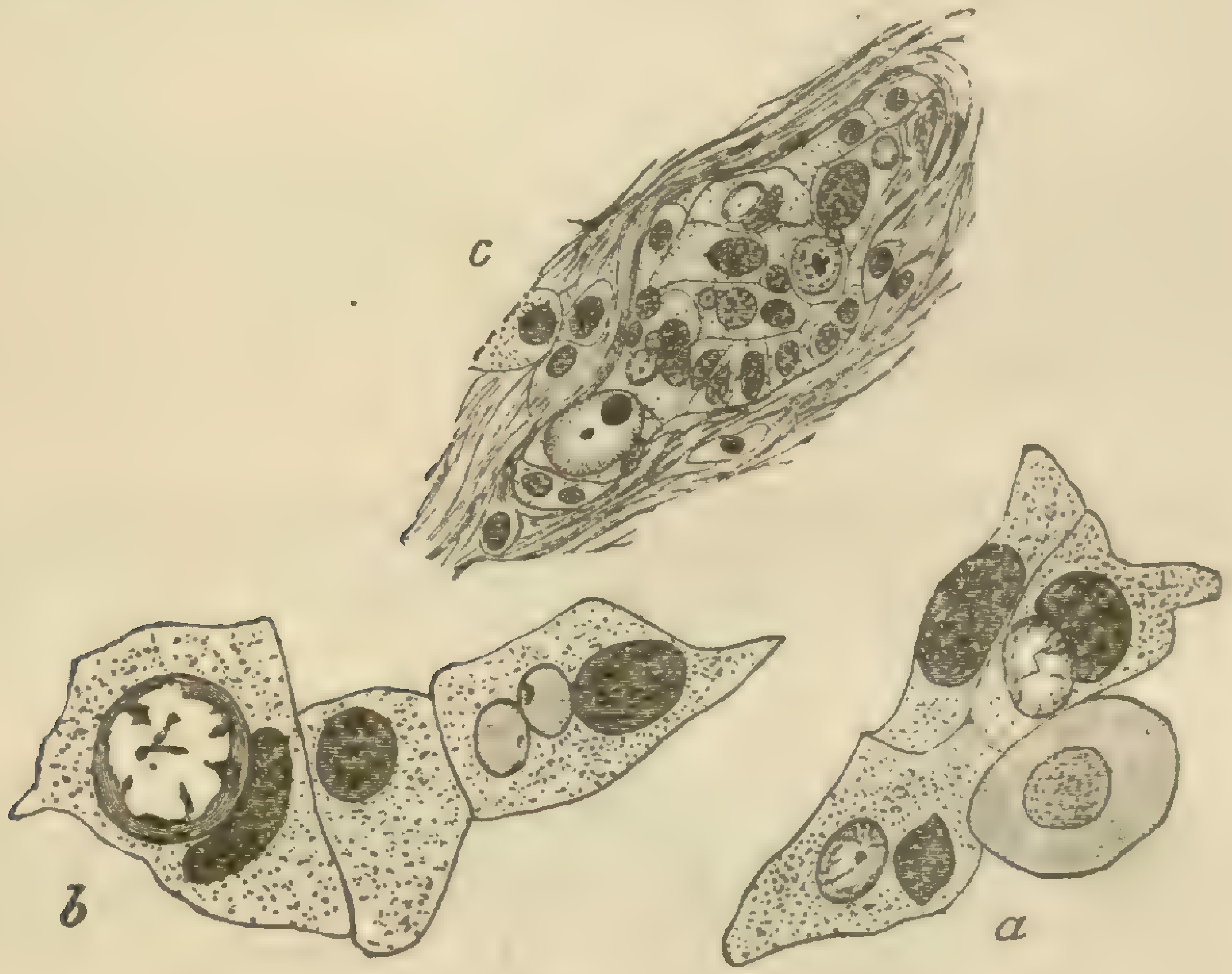


FIG. 4.

a and *b*, Groups of cells containing intracellular parasites × about 1,000; *c* cancer alveolus from edge of rapidly growing carcinoma of breast, showing numerous parasites × about 400.

bodies may be seen partly within and partly without the nucleus in the act of passing through the latter into the cell protoplasm. In certain cases the nucleus seems to become filled up with numerous small parasites which escape into the cell protoplasm after having burst through the nucleus.[4] The

[4] See "Preliminary Note on some Parasitic Protozoa found in Cancerous Diseases." By M. Armand Ruffer, M. D. and J. Herbert Walker, M. A. *B. Medical Journal*, July 16, 1892.

Also, "Recent Researches on Protozoa and Disease." By M. Armand Ruffer, M. D. *B. Medical Journal*, Oct. 14, 1893.

nucleus of the cancer cell when it bursts through over-distension with parasites, perishes, but when only one or two parasites escape, it usually heals up perfectly.

For the further life history of protozoa of cancer, we may follow Mr. Jackson Clarke.[5] In describing his examination of a myeloid sarcoma, he says: "In the most interesting portion of the neoplasm, its advancing border, the entire peripheral zone of the section could be examined from end to end without anything but amœboid psorosperms and remains of infiltrated connective tissues coming into view. In the centre of the field [Fig. 5] is a psorosperm in the plasmodium stage, in which spore-formation is commencing. Below is part of a giant cell containing one encapsuled and two amœboid psorosperms; numerous free amœboid parasites, and to the left is part of a large plasmodium, within which are nuclei and fibres undergoing digestion.

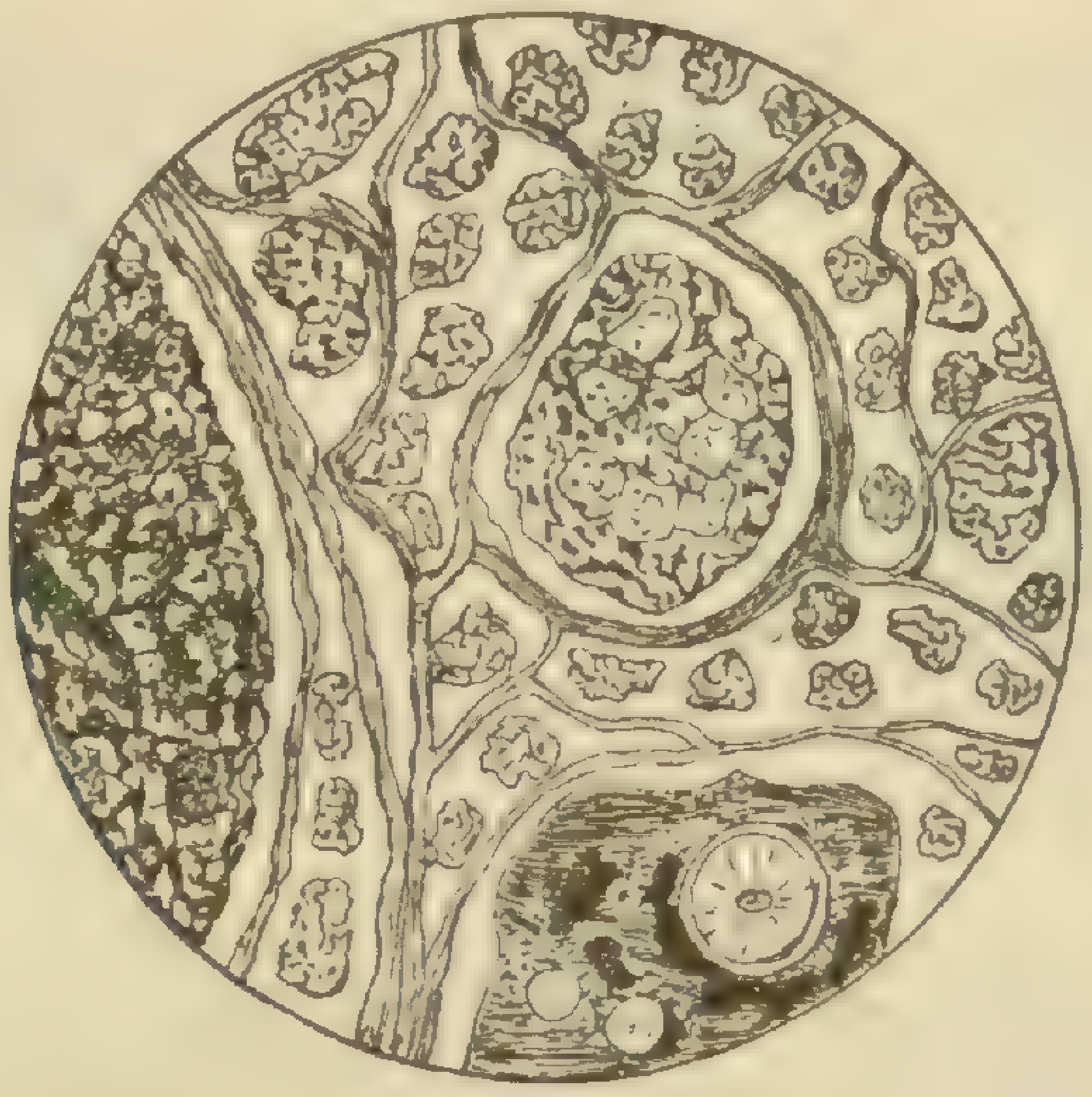


FIG. 5.

In this sarcoma, as in all the cancers, I have examined recently, there is, in the advancing zone, an army of amœboid psorosperms invading and digesting the tissues beyond, and *determining new growth in the special tissue with which the parasites have established a symbiosis.* For it appears that the curious inter-dependence of two organisms, known as symbiosis, has

[5] Sarcoma Caused by Psorosperms. By J. Jackson Clarke, M. B., F.R.C.S. *B. Medical Journal*, Dec. 24, 1892, and Jan. 21, 1893.

been established between the malignant parasite of cancer and certain epithelial and mesoblastic tissues. *These tissues are excited to enormous overgrowth by the presence of the parasites, whilst the tissues with which they have not established a symbiosis are invaded, devoured and destroyed.* Mr. Jackson Clarke thus describes the process: "The amœboid parasites make their way between the epithelial cells and pass in vast numbers into the connective tissue spaces beyond the epithelial part of the growth. In their passage they cause the rows of epithelial cells to separate, and thus bring about a multiplication of the points of epithelial ingrowth and detachments of small groups of epithelial cells. A considerable amount of inflammation is caused by the invasion of the vascular tissues by the amœbæ, with the same result as that seen in inflammatory papillomata; an extension of epithelial growth, and a formation of new blood-vessels. Most of the amœbæ disappear, but a small proportion enter epithelial cells, where, even in the non-nucleated stage, they could be detected," and the evil cycle is carried on.

Messrs Ruffer and Walker, the first pathologists who demonstrated the existence of the cancer parasite in England, state that they found a mixture of Foll's solution, with 1 per cent. of osmic acid, gave the most satisfactory results as a hardening reagent,[6] especially in demonstrating the intranuclear parasites. Biondi's mixture as a coloring agent brings out the organisms with all the clearness that can be desired. The "coccidia, stained a light blue, enclose a dark brown nucleus, the cancerous cell is stained a dirty yellow white, while its nucleus takes a green tint" [Metschnikoff].

Metschnikoff is of opinion than the coccidiosis of the rabbit is a miasmatic disease of the most typical kind, and that carcinomata also approximate to the category of miasmatic affections. "Although less pronounced than malaria or goitre," he observes, "the endemic character of cancer is a fact that has often struck observers. The frequency of these malignant tumors is far from being the same in all countries. By the side

[6] Second Note on Parasitic Protozoa in Cancerous Tumors. *B. Medical Journal,* Nov. 5, 1892.

of regions of the globe which are exempt, or very nearly so, from this disease [Faroë Islands] there are others where carcinomata are very common." According to Cohnheim's theory of a simple overgrowth of embryonic survival tissues, the average of victims to cancer should be the same in every part of the world, and liability to its ravages should be common to all the Metazoa. Metschnikoff points out another feature which cancers have in common with coccidian diseases—the exaggerated proliferation of the epithelial cells in the affected organs. How close the resemblance is, the following figures show.

FIG. 6.

Adeno-Carcinoma of the Rectum in Man.

FIG. 7.

Hyperplasia of the biliary ducts of the rabbit under the influence of coccidia.

As yet, the study of parasitism in cancerous diseases is only beginning. The coccidia of the rabbit have been known for

half a century, but it is only quite recently that an important stage in their life-history has been made out. There are differences of opinion between observers; Mr. Jackson Clarke's amœba-like organisms do not exactly correspond with the various forms of parasites described by some other pathologists. It is thought possible that the whole life-cycle of the protozoön may be passed within its human host; in any case, its exogenous history is not known, and this stage is the one which it would be the most useful to discover, since we are, at present, in utter darkness as to the mode in which the contagion is conveyed to the host. Cancer is pronounced to be a disease in which heredity plays an important part. Does it do so in the same way that hereditary predisposition acts in tuberculous diseases; not by a direct transmission of the tubercle bacillus, but by some mysterious lowering of the vital powers of resistance? It is hardly possible to imagine that microsporidia, hereafter to develop into the protozon of cancer, can remain dormant for 50, 60, 70, 80 years.

The disease [so far as can be ascertained from experiments upon animals, themselves liable to cancer] is not directly transferable from one host to another. There remains, therefore, as a highly probable hypothesis that the exogenous form of the protozoön of cancer, like the flagellate monad of malaria and the coccidia of the rabbit, must be sought in contaminated soil or water. It is because this most important stage of the life history of the protozoön of cancer is unknown, that I have ventured to present a summary of some of the papers which have been appearing for some months in the *British Medical Jonrnal* to the readers of the AMERICAN NATURALIST; hoping that workers skilled in researches among the Protozoa may take up the subject, and may come to the aid of the brilliant band of pathologists who have thrown so much light on a most difficult problem.

THE ACTION OF LEUCOCYTES TOWARD FOREIGN SUBSTANCES.[1]

EDITH J. CLAYPOLE, M. S.

Among the many problems that yet await solution at the hands of the physiologist and histologist, those relating to the disappearance of so many leucocytes or white blood corpuscles from the animal body have long afforded a fruitful field for work. Under what conditions and by what means they are destroyed is as yet but partly known, and different theories are advanced as to the most probable method of this destruction. The constant relation, normally, that exists between the numbers of the white and red cells of the blood, in spite of the steady supply of white cells that is poured into the blood from the lymphatics, establishes the fact that somewhere there is as steady a drain on the numbers.

The nature of leucocytes as entities in the economy of the animal body is of especial importance in consideration of the second point and a careful study of these cells in a living condition helps one to realize their activities and powers. The ability of these cells to take up foreign substances by virtue of their amoeboid movement is very significant to the physiologist especially from a pathological standpoint. The great Russian morphologist, Metschnikoff, has based his phagocyte doctrine on the peculiarity given to these cells by the exercise of this power, giving to them in consequence an additional and important duty. They form, as it were, a guardian army in the animal body, ever alert and watchful for the invading enemy. A constant warfare is being waged between these leucocytes and all foreign material, organic or inorganic, that enters the system. By the process of ingestion the immediate influence

[1] This paper contains part of the results of an investigation carried on in the Histological Laboratory of Cornell University during last year. I wish to express my appreciation of the abundant material and facilities which were so generously put at my disposal. The whole paper afterwards received the first prize offered by the American Microscopical Society for original work in animal Histology.

of the substances is removed from the tissues. The balance of power continually wavers between these two hosts, on the one hand the leucocytes and on the other the different kinds of organisms and matter, injurious or non-injurious, to which the animal body is hourly exposed. If the invaders are too strong the results become evident in the sickness or perhaps death of the animal. But if the leucocytes are victorious, and are able to clear the system of the foreign substances, normal conditions are again established and with them the health of the individual. By no means is it necessary, however, that the conflict become apparent externally. This at least is the story picturesquely put as the founder of the "Phagocyte Theory" reads it. It may be rather extreme; certainly there are those who consider the protective part played by the leucocytes to be quite small, relatively speaking or merely incidental. That they can and do ingest foreign particles and are subsequently to be found in the various tissues bearing their loads, is however, proved. It is only the interpretations laid on the facts that differ.

Many experiments have been made from a pathological standpoint to prove, if possible, the true part played by the various tissues and cells in diseases, which owe their existence to the presence of foreign matter or foreign organisms in the body. Naturally from the medical standpoint these experiments have been made on mammals of various kinds, the only other animal used being the ever useful frog. In contrast to this basis of work is the normal physiological condition existing under ordinary circumstances in animal life. All the experiments, of which the results are here given, were made under as purely normal conditions as possible, in every way anything that might produce abnormal results, being avoided. The animals used for these experiments were the two salamanders, *Necturus maculatus* or the Mud-puppy and *Cryptobranchus alleghaniensis*, the Hell-bender.

For several reasons these animals afford peculiar advantages for an investigation of this kind. Of great importance among these is the large size of the leucocytes and of the various tissue cells, and also the comparatively simple structure of

the different organs. Another great advantage in the study of the living leucocytes lies in their activity in the ordinary temperature of a room, a fact, which affords an opportunity for the close observation of the process of ingestion. By mixing on a slide a small drop of fresh blood or lymph with a small quantity of lamp-black suspended in normal salt solution, the taking up or ingestion of the carbon by the leucocytes can be seen to take place while they pass through their amoeboid phases. In a few hours the cells become filled with carbon particles (Pl. IV), which are, however, contained exclusively in the cell body although appearances suggest their presence in the nuclei. These latter parts also exhibit amoeboid forms (Pl. IV). By watching the cells carefully the granules are seen to move across the nuclei and gradually leave it clear, proving beyond doubt that they are in the cell body.

In introducing the carbon into the living animals the following method was used. Into the abdominal cavity of the animals from ¼–1 c. c. of a mixture of lamp black, gum arabic and normal salt solution was injected. Here it should be said that in these animals this cavity forms practically a great lymph space, in which the carbon is ingested by the leucocytes, the latter then pass into the blood circulation and from that to the various organs and tissues. After periods varying from 4–10 days different animals were killed and the blood and tissues examined. In the case of Necturus, owing to the presence of external gills, the time of the appearance of the carbon-laden cells in the blood could be easily determined. By etherizing the animals and microscopically examining the circulation of the blood in the gill filaments once or twice a day the time of the appearance and also of the disappearance of ingested cells can be noted. The earliest appearance was on the 6th and the latest on the 9th days after injection. After 16 days a few scattered cells still remained. The results now given were chiefly obtained from a specimen of Cryptobranchus killed 10 days after injection.

In the microscopical examination of the tissues the first difficulty encountered lay in the presence of a large amount of natural pigment in the tissues. This is confusing both from

the similarity in colour and from the necessary obscuring of structural parts. Caustic potash destroys melanin, but boiling is required and that of necessity injures the tissues. Ether, alcohol, acids and strong alkalies will also remove the colour, but the last two destroy the tissues and the first two decolorize so slowly as to be practically useless. By means of hydrogen dioxide the most successful results were obtained. The sections when cut and fastened to the slide were put in a vial of a 2% solution of the liquid. In from 6–48 hours, depending on the amount of pigment present, the color is reduced from black to a pale yellow without any attendant injury to the tissues. The process of decolourization is materially hastened by placing the vial containing the liquid and tissue in the strong sunlight and if desired all traces of the pigment can be removed. Practically it was found to be a great advantage to leave sufficient colour to mark the position of the pigment-bearing cells. By this method the black ingested leucocytes were easily distinguished wherever they occurred, and no chance for confusion remained.

Serial sections were made of the following parts: the spleen, kidney, ureters, liver, lung, stomach, muscle and skin. In all these parts ingested cells were present, but the positions and relations differed somewhat with the different organs. In the kidney (Pl. VI) carbon-laden leucocytes were in the blood capillaries, in the glomeruli, in the lymph spaces surrounding the capsules of the glomeruli, in the urinary tubules and in the nephrostomes. These latter parts are peculiar structures present in the amphibian kidney and are marks of a much more primitive form of that organ than exists in mammals. They consist of small ciliated funnels opening on the ventral surface of the kidney directly into the abdominal cavity. A small tube then unites these funnels with the urinary tubule arising from the glomeruli. The ingested leucocytes were in these funnels and by a series of sections they could be found to pass down the tube and into the urinary tubule. No doubt the number of leucocytes that pass from the blood circulation into the tubules is largely increased by additions from this source. No signs of ingested leucocytes in other than these

places were found, or any trace of free carbon. Serial sections made of the ureters (Pl. VI) close to their openings into the cloaca showed masses of ingested cells. This indicated that a considerable number of such cells found their way out of the body in this way. Uningested cells were also found among those containing carbon. In the liver (Pl. V) ingested cells were found in the blood vessels alone. No extra-vascular carbon-laden leucocytes were present. In the stomach (Pl. VII) the carbon-laden cells were in the blood-vessels, in the epithelial tissue of the stomach and free on the inner surface, showing a gradual passage from the vessels to the epithelial surfaces. In the lungs (Pl. VI) practically the same time condition existed and also in the skin (Pl. VII). In the latter leucocytes could be traced from the blood-capillaries through the various layers and finally free on the outer surface of the skin. That these outside had not come from accidental external contact was proved by the fact that no red corpuscles were among these leucocytes and with the very rapid coagulation that takes place in amphibian blood it would be impossible for the white cells to be completely isolated from the red. In various parts of the muscular tissue, either in the lymphatics or simply between the muscular fibres, ingested cells occurred rarely.

In all these parts there was absolutely no evidence for the presence of free carbon or carbon in any other cells than leucocytes. When, however, the spleen (Pl. V) was examined some peculiar and very interesting differences were found. The carbon was contained in leucocytes of a similar nature to those in previous cases, but in addition round the malpighian corpuscles there was what seemed at first sight to be a free deposit of carbon. But when carefully observed the carbon proved to be contained in cells that from their position were judged to be spleen-pulp cells. The distribution of the carbon in these cells differed exceedingly from that present in the leucocytes. Instead of being massed irregularly the carbon was evenly scattered through the cells, and, owing to the extended condition of the latter, covered a large area. When the fact of the presenee of carbon in these cells was established the question of the means of the transfer of the carbon from

the leucocytes to the spleen cells at once arose. It was already proved that no free carbon entered the blood circulation. Consequently the spleen cells must have obtained their foreign material either directly or indirectly from the already ingested leucocytes in the blood. Two ways are open for this to take place. The leucocytes may in some manner discharge their load, which is afterwards taken up by the spleen cells, or the spleen cells may ingest the leucocytes and consequently the carbon. The latter seems to be the most plausible explanation. Moreover from the amount of carbon contained in the spleen cells the number of leucocytes destroyed in this manner must be considerable.

A brief summary of the results of the experiments is contained in the following statements:

1. No free carbon was present in any part examined.
2. All carbon was contained in leucocytes except in the spleen, where true splenic cells also contained it.
3. Ingested cells were both extra- and intravascular, except in the liver.
4. Ingested cells were free on mucous and epidermic surfaces; in the stomach, lungs and skin.
5. Ingested cells were in excretory organs with waste products, kidneys.

From the above results it is seen that the number of leucocytes in the body suffers a constant loss in three ways, by the wandering out of the cells on mucous and epidermic surfaces, by passing away with waste products and through ingestion by the splenic cells. The large numbers found in all three conditions show that the destruction of leucocytes through these ways is by no means insignificant. Moreover as no pathological conditions, so far as could be determined, were induced in the animals by the treatment, there is no reason to believe this loss to be other than a normal occurrence.

This method of removing the artificially introduced material by the leucocytes suggests at least the manner of the removal of any foreign matter that may enter the circulation during life. The leucocytes thus perform the duties of scavengers of the body in addition to their other important duties, even if by

the very assumption of this office, they ultimately become waste material and as such pass away from the system.

One of the most interesting of the many problems that, even in these few experiments, have presented themselves, remains as yet unsolved. Owing to want of time the ultimate fate of the carbon contained in the spleen-pulp cells remains unascertained, nor can any suggestions be offered. Only after more prolonged experiments could it be determined whether the carbon disappeared from the cells or remained permanently in them. After the determination of this point if the first condition was found to obtain, the question as to the method of this removal would remain to be settled. In all the problems connected with the blood and circulation this perplexing organ seems to play an important part and when, setting aside function, differences of opinion exist as to structure, it can easily be seen that discussion on this part of the experiments involves doubtful and difficult problems. As is usual in any investigation many doubtful points have been raised that yet await settlement, leaving an interesting and fruitful field for further work.

NOTE.—The author wishes to express her indebtedness to the American Microscopical Society for the use of plates illustrating this article.

PLATE IV.

Leucocytes.

A. Group of carbon-laden leucocytes showing amoeboid phases.
  a. b. Leucocytes of Necturus.
    n. Nucleus.
    p. Cell-body.
  c. d. Leucocytes of Cryptobranchus.
    n. Nucleus.
    p. Cell-body.
 Drawn from dried preparations.

B. Group of Leucocytes, showing amoeboid cell-bodies and amoeboid nuclei.
  a. b. c. Leucocytes of Necturus.
    n. Nucleus.
    p. Cell-body.

b. Shows three nuclei, two in amoeboid movement and one resting.
d. e. Leucocytes of Cryptobranchus.
n. Nucleus.
p. Cell-body.
e. Has three nuclei, two amoeboid and one resting.
Drawn from stained preparations.

Plate V.

A. Surface section of liver of Cryptobranchus.
p. Capillaries of blood-vessels.
t. Liver-cells.
b. Red corpuscles in the capillaries.
d. Small intercellular capillaries of bileduct.
e. Epithelium of the larger bile vessels.
h. Hepatic cell-body.
n. Nucleus of hepatic cells with nucleoli.
Note the absence of extravascular ingested leucocytes.
B. Vertical section of the spleen of Cryptobranchus.
I. Part of the section near the surface.
1. Peritoneum.
2. Layer of fibrous tissue forming the capsule.
3. Trabeculæ passing from capsule among splenic cells.
c. Carbon-laden leucocytes.
b. Red corpuscles.
l. Leucocytes, non-ingested.
s. Splenic pulp-cells.
II. Ental part of the section.
Lettering as above.

Note the ingested spleen pulp cells and the different distribution of the carbon particles in them from that found in the leucocytes; also the absence of ingested splenic cells in the superficial part of the spleen.

Plate VI.

A. Vertical section of lung of Cryptobranchus.
E. Ectal surface.
R. Ental or respiratory surface.

P. Blood capillary.

c. Carbon-laden leucocytes.

Note the presence of ingested leucocytes in extravascular tissue as well as on the ental surface of the lung.

B. Section of kidney of Cryptobranchus.

I. Transection of the ureters and cloaca, showing masses of ingested cells.

a. Ureters.

c. Carbon-laden leucocytes.

l. Non-ingested leucocytes.

II. Transection of urinary tubules.

c. Carbon-laden leucocytes.

III. Nephrostomic funnel, showing ciliated mouth.

c. Ingested leucocytes.

l. Non-ingested leucocytes.

IV. Vertical section of the kidney near the ventral surface.

G. Glomerulus.

P. Capillaries of blood-vessels.

T. Urinary tubules.

s. Lymph space around the glomerulus.

o. Origin of a urinary tubules, with small ciliated epithelium.

b. Red corpuscles.

c. Carbon-laden leucocytes.

Note the presence of extravascular ingested cells.

PLATE VII.

A. Vertical section of stomach of Cryptobranchus, near the pyloric part.

I. Submucosa.

II. Muscularis mucosæ.

III. Mucosa.

c. Carbon-laden leucocytes.

Note the presence of the extravascular ingested cells.

The figure is diagrammatic in so far that the locations of the ingested cells are taken from different sections and put into one figure.

PLATE VI.

Sections of Lung and Kidney of Cryptobranchus.

B. Vertical section of the skin of Cryptobranchus.

G. Large mucous glands.

c. Carbon-laden leucocytes.

The ingested cells are wandering to the external surface from the blood-vessels.

THE WHITE-MARKED TUSSOCK-MOTH (ORGYIA LEUCOSTIGMA SMITH AND ABBOTT) IN CHICAGO.

Dr. Joseph L. Hancock.

Throughout the months of June and July 1893, there were myriads of caterpillars of the White-Marked Tussock-Moth (*Orgyia leucostigma*) crawling on the sidewalks, in the grass and in the streets in the section south of the river in Chicago. These caterpillars could be seen constantly changing their positions, drifting from place to place. One need not have searched far to determine the cause of these shifting movements—for the White Elm trees (*Ulmus americanus*) which are set out in some of the resident portions, on the sides of the streets, at that time were almost completely defoliated; showing that they were infested by this insect. As soon as one tree became despoiled of its leaves the caterpillars centered their attacks upon other trees adjacent to them. The beautiful hairy larva of Orgyia marked with yellow, black, and two little bright vermillion red spots on the ninth and tenth joints is a conspicuous object. It seems to have few natural enemies and parasites that are menacing its welfare here.

Notwithstanding the possible existence of a few deadly foes, it enjoys immunity from these to a larger extent than many other insects, as shown from the fact of the growing preponderance of individuals in the last three years. The Wheel-bug sometimes attack the caterpillars, but the former does not occur in the city, whereas bats, cuckoos and robins are in insufficient numbers to make any appreciable impression on them. In the middle or latter part of August, the male moths are most abundant, flying about at night. Attracted by artificial lights, they frequently are seen on the glass of the shop windows along the streets. One appeared on the inside wall of a house (August 28, 1893) and was caught by the writer. The position of the hairy forelegs placed in front of the body,

with other characteristics which it possesses, are attractive to the entomologist. Natural selection has favored the structure of the legs, the feathery antennæ, the subdued ashy-gray color, all to one purpose; to lend in blending its form with the natural environment on the bark of trees. In fact we find

Fig. 1. White-marked Tussock-moth: *a*, female moth on cocoon; *b*, young larva hanging by thread; *c*, female pupa; *d*, male pupa; *e*, male moth. [After Riley].

the caterpillar favored by its very conspicuousness, while nature is effecting good to the same species on a diametrically different line by so modifying the form of the male moth as to deceive its enemies from seeing it. Parasitism may be looked upon as a recent enemy—for nature is strangely unable to cope against their invasion. The female pupa within a frail cocoon may be pierced with ease by the ovipositor of a Hymenopterous parasite and is obliged to give up her life's juices in hopeless submissson to the offspring of the parasite hatching within her body. Along these lines we are to look forward for a means of extermination. On September 30, 1893, the tree trunks along the streets in the locality above named, were examined with a view of learning some further facts about Orgyia. A number of cocoons were found as the result of the search, all being near the ground. These were taken home to my study, where on opening them, they proved to be quite old, of a dirty color, and many were deserted. On two of the cocoons there were plastered masses of small white eggs made adherent by some glistening tenacious frothy substance which had become hardened on drying. Inside of others were empty pupas and cast off skins. Some Hymenopterous parasites had hatched and lived in the old pupa husks, which later had made their exit through an irregular hole cut

out at the forward end. In another cocoon there still lay in store another suprise, for on tearing apart the hairy fibers, out rolled a small undetermined gray spider which was snugly secreted and warmly covered for the winter. The spider was tumbled into a bottle of preserving fluid and now bears testimony to the unprofitable experience of tenanting a ramshackle old dwelling of Orgyia.

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RECENT LITERATURE.

Chapman on the Birds of the Island of Trinidad.[1]—During the early part of 1893, Mr. Chapman collected birds and made notes in the Island of Trinidad, and the paper we are here to notice is the printed account of his observations in that interesting quarter of the world. Its author leads off with a brief description of the Island and the various places upon it visited by him during his short stay there. Then follows several pages devoted to "The Faunal Position of Trinidad," in which he very conclusively proves that that island "faunally, that is naturally, has no connection whatever with the West Indies, but is entirely South American in its affinities." Further we are informed that an "analysis of the distribution of the 199 resident land-birds common to Trinidad and the continent shows that it belongs in the Colombian, rather than in the Amazonian subregion. Thus 153 of these birds are found in both Guiana and Venezuela, while twenty-five are found in Venezuela but not in Guiana, and only eleven are found in Guiana but not in Venezuela." An interesting table is also given showing the South American element in the avifauna of Trinidad, as compared with the off lying islands of Tobago and Grenada.

Mr. Chapman also deals in this paper with the Bibliography of the Trinidad Avifauna, and an entire and very important section of the work is devoted to "General Remarks on Trinidad Bird Life." Here the questions of "Number of Species;" "Migration;" "Call-Notes and Songs;" "Nesting" and "The Colors of Tropical Birds" are dealt with in a manner well calculated to excite the interest, and compel the attention of the philosophic student of bird-life in any part of the world where these observations may be read.

This memoir is concluded by "A List of the Birds of the Island of Trinidad," which is prefaced by the following remark by its author: "While I believe that the most natural order in which to arrange lists of species of any class of animals is to begin with the lowest forms and end with the highest, most writers on South American birds have followed exactly the opposite plan, and any attempt to change would now result in so much confusion that I have decided to follow the system of

[1]CHAPMAN, FRANK M., *On the Birds of the Island of Trinidad.* Author's Ed. ext. Bull. American Museum of Natural History, Vol. VI, Art. 1, pp. 1–86. New York, Feb. 16, 1894.

previous writers, even though I disapprove of it." (p. 21). We cannot agree with Mr. Chapman in this theory, and see no real valid reason why we should perpetuate the errors of our predecessors in the science of ornithology.

The classification of the birds of Trinidad adopted by Mr. Chapman is the only faulty feature of this otherwise careful work by a Naturalist who has thus far in his career earned a reputation for great painstaking.

He divides the Trinidad avifauna simply into two primary ORDERS —the PASSERES and the MACROCHIRES.

In the first named the following families are represented, viz: the *Turdidæ;* the *Troglodytidæ* [Sic.]; the *Mniotiltidæ;* the *Cœrebidæ;* the *Vireonidæ;* the *Hirundinidæ;* the *Tanagridæ;* the *Fringillidæ;* the *Icteridæ;* the *Tyrannidæ;* the *Pipridæ;* the *Cotingidæ;* the *Dendrocolaptidæ;* and the *Formicariidæ.*

This may answer for the Passeres, but his order Macrochires is very carelessly arranged. In it he retains the "Humming-birds, Swifts, Goat-suckers, etc.," and leads off with the family *Trochilidæ,* between which and the Swifts there appears no family dividing line; nor is there between the Swifts and the Goat-suckers. The "etc." given above seems to include also without dividing family lines, Wood-peckers, Kingfishers, Trogons, Jacamars, Cuckoos, Toucans, Parrots, Owls, Vultures, Hawks and Pigeons, Jacamas, and indeed all the rest of the avifauna of the Island, including all the water-birds. At the close of the "list" some of the birds are enumerated entirely in their wrong places in the system. I refer to the point where *Crypturus pileatus* follows *Colymbus dominicus.*

The writer of this review has long since failed to recognize the naturalness of the so-called order "Macrochires," but here certainly is an application of it that is, at the best, quite unique in ornithological literature.—R. W. SHUFELDT.

Memoirs of the National Academy of Sciences, Vol. VI,[2] embraces 331 pages, of which the following is the list of contents;—On the Capture of Comets by Planets, especially their Capture by Jupiter, by H. A. Newton.—Atmospheric Electricity, by Robert Catlin, U. S. A.—On Certain New Methods and Results in Optics, by C. S. Hastings.—The Proteids or Abuminoids of the Oat Kernel, by T. B. Osborne.—A Comparison of Antipodal Faunas, by Theodore Gill.—Families and Sub-Families of Fishes, by Theodore Gill.—Human

[2]Memoirs of the National Academy of Sciences, Vol. VI. Washington, 1893.

Bones of the Hemenway Collection in the U. S. Army and Medical Museum, by W. Matthews, Surgeon, U. S. A., Dr. J. L. Wortman and Dr. J. S. Billings.—Further Studies on the Brain of *Limulus polyphemus*, with notes on its Embryology, by A. S. Packard.

Four of the eight memoirs are profusely illustrated.

A Dictionary of Birds.[3]—Under this title, Professor Newton publishes a series of articles contributed to the ninth edition of the Encyclopedia Britannica, modified and supplemented by recent acquisitions to the knowledge of the Avian history. The contributions of Dr. Gadow bring the anatomical portion up to date, and those of Dr. Lydekker furnish the paleontology. The material is arranged in alphabetical order and includes the names of birds in common use, excluding local names except such as have found their way into some sort of literature; technical terms; and all of the important branches of Ornithology; as flight, migration, extermination, embryology, eggs. color, geographical distribution, etc.

Lophopsittacus mauritianus M-Edw.; the extinct parrot of Mauritius.

The numerous illustrations add to the attractiveness of the work. Many of those representing the bill, wings and feet, are those pub-

[3]A Dictionary of Birds, by Alfred Newton; assisted by Hans Gadow; with contributions from R. Lydekker, C. S. Roy and R. W. Shufeldt. Pt. I and II. London, 1893, Adam and Charles Black, Publishers.

lished many years ago by Swainson, which have never been excelled for expressiveness.

The Dictionary is one which every Naturalist should have at hand, as furnishing in convenient form full information in every department of the subject. The work is critical, and the conclusions of its authors carry with them the weight of their well known mastery of the subject. The treatment of questions of nomenclature is especially to be commended. As they insist on correct orthography, and discard names published without descriptions, or which are flagrantly incorrect in meaning, they furnish a much needed corrective to tendencies to pursue an opposite course, which are just now too prevalent in this country. We give some examples of the cuts which illustrate the two volumes already issued.

FIG. 1. *Odontopteryx toliapicus* Owen. English Eocene.

Eleventh Report of the State Mineralogist of California.[4] —This report, as originally submitted to the Board of Examiners, consisted of over 2,000 pages of manuscript, much of which, while valuable in itself, would be of no practical use to the miners in whose interest the volume was prepared. It was accordingly put in the hands of Mr. Charles G. Yale for revision. By judicious omission and conden-

[4] Eleventh Report of the State Mineralogist, Wm. Ireland, Jr. (First Biennial) Two years ending September 15, 1892. Sacramento, 1893.

sation he reduced the copy to 844 pages of manuscript which, together with the illustrations, makes an octavo of 612 pages. The report is confined almost exclusively to mining in the counties of California, the exceptions being a paper on Hydraulic Ejectors, by Mr. E. A. Wiltsee, and a dissertation upon American mining law, by A. H. Ricketts.

The prefatory report of Mr. Ireland includes an interesting synopsis of the results of the geological investigations of the different field assistants.

The engravings for this report add materially to its value.

Annual Report of the Canadian Geological Survey, 1890-91.[5]—This volume, of 1,556 pages, consists of 13 separate reports, bound in two parts, with maps and illustrations descriptive of the geology, mineralogy and natural history of the various sections of the Dominion to which the several reports relate. These have been published separately at intervals during the past two years, and abstracts of many of them have been given in previous numbers of this journal

Eleventh Annual Report of the Director of the U. S. Geol. Surv.[6]—This volume contains a report of the work of the divisions of Hydrography and Engineering during 1889–90, the statement of the Director to the House Committee on Irrigation, the report of Mr. A. H. Thompson, geographer, and an account of the disbursements of money. The statement of the Director comprises a general discussion of the problems of irrigation in the arid lands of the United States, and a résumé of the larger aspects of the problem, as well as other facts of general interest.

The text is illustrated by several maps and cuts of measuring instruments in use by the Survey.

Annual Report of the New Jersey Geological Survey for 1892.[7]—The investigations carried on in the several departments of the Survey are embodied in the report of the State Geologist under the following heads: Surface Geology, R. D. Salisbury; Cretaceous and and Tertiary Formations, W. B. Clark; Water-Supply and Water-

[5]Annual Report Geological Survey of Canada, 1890–91, Vol. V. Parts 1 and II. Ottawa, 1893.

[6] Eleventh Annual Report of the U. S. Geol. Surv. to the Secretary of the Interior, 1889–90. By J. W. Powell, Director. Part II, Irrigation. Washington, 1891.

[7]Annual Report of the State Geologist of New Jersey for 1892. Trenton, N. J., 1893.

Power; C. C. Vermeule; Artesian Wells, L. Woolman; The Sea-Dikes of the Netherlands and the Reclamation of Lowlands and Tide-Marsh-Lands, J. C. Smock.

In the administrative report, Mr. Smock calls attention to the desirability of securing the Highlands for a forest reservation, and a permanent gathering territory for a water-supply, and refers somewhat at length to the subjects reported upon by the heads of the several divisions.

The illustrations consist of maps, diagrams and plates. Among the latter are three reproductions from the Challenger Expedition Report on Deep Sea Deposit.

Marbles and Limestones of Arkansas.[8]—This report, by T. C. Hopkins, represents Volume IV of the Annual Rept. of the Arkansas Geol. Surv. for 1893. Part I consists of an introductory chapter giving a general description of the marble area of the State, followed by a discussion of limestones in general, including their composition and origin, geological and geographical distribution, varieties and uses, and a detailed description of the different limestones of Arkansas. In part II the author states briefly the origin and uses of marble, gives a résumé of the marbles of United States and other countries, and describes in detail those of Arkansas, giving especial attention to their use for building purposes. In order to make the work of practical value in establishing a marble industry in the State, two chapters are devoted to quarrying and the preparation of the stone.

The text is illustrated by a number of good plates, and a set of six map sheets.

[8] Annual Report of the Geological Survey of Arkansas for 1890. Vol. IV, Marbles and other Limestones. By T. C. Hopkins, Little Rock, Ark., 1893.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Discovery of a New Fauna in the Cenozoic Beds near Zagreb, and its Relations with the Recent Fauna of the Caspian Sea.—For a number of years, Professor Brusina of the University of Zagreb has been studying the Molluscan fauna of that region. In a recent publication he reports finding a wonderfully rich fossil bed at Markusevic from which he obtained 101 species, over half of which are new. A generic comparison of the fauna of Markusevic with that of Okruljak shows that the Pelecypoda are the dominant type in the latter locality, while the gasteropods prevail in the former. A comparison of the fauna of these two localities in Croatia with the recent fauna is of extreme interest. To quote Professor Brusina, "They seem to have relations with the fauna of Lake Baikal; my new genus, Baglivia, is similar to the genus Liobaikalia Martens (Leucosia Dybowski). Also some of our Valvata recall some species of the same genus which live in Lake Baikal.

"I have mentioned the genus Caspia. Dr. W. Dybowski, to whom we are indebted for the most important papers on the Gasteropods of Lake Baikal and of the Caspian Sea, created this genus for a series of small species which live in the Caspian Sea. Now, I have discovered near Zagreb several fossil species of the same genus. In a paper published in 1884, I established the genera Zagrabica and Micromelania for some fossils found near Zagreb; in 1891, in the work referred to on the recent Molluscs in the Caspian Sea, Dybowski describes several species of Micromelania and one species of Zagrabica now living in that sea. Thus, the genera Zagrabica, Micromelania, Caspia and Limnocardium (Adacna), fossil in Croatina, are to-day living in the Caspian Sea. It is, then, evident that the present fauna of this sea is the remnant of the rich fauna of the Congeria beds of Austria, Hungary, Banat, Croatia, Slavonia, Servia, etc., although, quite recently this fact has been doubted.

"A comparison between the fossil fauna of the neighborhood of Zagreb with the recent fauna of the Caspian Sea destroys the hypotheses of Humboldt, Peschel, Middendorf and others, concerning the origin and relationship of the Caspian Sea and of its present fauna. While these authors claim the origin of the fauna of the Caspian Sea, in the Black and circumpolar seas, my studies and my researches lead me to look for its origin in the pre-pleistocene Cenozoic beds of Croatia

and in those of the other countries above cited." (Proceeds. Congrés. Internatl. de Zool. Deuxiéme Sess. a Moscou, 1892. Deuxième Partie Moscou, 1893.)

Coasts of Bering Sea and Vicinity.—Mr. G. M. Dawson's notes on some of the coasts and islands of Bering Sea confirm the theory of a former land connection of Asia and North America in that region. Soundings in Bering Sea show that the continental plateau of North America extends westward in Bering Sea, meeting with that of Asia in the vicinity of Cape Navarin, north latitude about 60°. The available evidence shows that this submarine plateau, together with much of the flat land of western Alaska, was covered by a shallow sea during the later part of the Miocene period. The formation of the Aleutian Islands began in the late Eocene or early Miocene, continued with vigor during Miocene, and later in an intermittent way up to the present time. No traces of glaciation by land ice were found in the Bering Sea region, and the absence of erratics above the sea-line shows that it was never submerged for any length of time below ice-encumbered waters. (Bull. Geol. Soc. Am. Vol. 5, 1894).

The Age of the Pliocene Mammalian Fauna of the Central Plateau of France.—M. Deperet recognizes two distinct and successive mammalian faunas in the different Pliocene horizons of Italy, France and England. First, an older one, belonging to the lower and middle Pliocene. It is characterized by a great number of old extinct forms, as Hippotherium, Hyaenarctos, Paleoryx, Dolichopithecus, many of the Glires, large Monkeys with Asiatic affinities, Antilopes related to the African species, and by the rarity of the relative simplicity of the horns of the Cervidæ. The absence of Equus, Bos and Elephas constitutes a negative character throughout all Europe. Second, a more recent fauna, found only in the upper Pliocene. The old genera, except the Mastodon, have disappeared; the horse supplants Hipparion; Bovidæ appear for the first time in Europe; Monkeys persist in Italy; *Elephas meridionalis* is found nearly everywhere with *Mastodon arvernensis* and *M. borsoni*.

In Italy the old fauna is badly represented by sporadic débris, but the recent types are found abundantly in the brackish and fluviatile deposits which overlie the marine Pliocene of Astesan, and in the fluviatile gravels in the valley of the Arno.

In the south of France the older fauna occurs and affords the best means of determining the exact stratigraphic position of the beds in which the fossils are found.

In la Bresse the older fauna is found in the lacustrine deposits of the lower Pliocene and in the fluviatile beds of the middle Pliocene; the recent fauna is finely developed in the sands of Chagny.

In England the Hipparion fauna is found in the nodule-beds at the base of the red Crag and in the red Crag itself, while the Equus fauna is contained in the fluvio-marine Crag.

A comparison of stratigraphic details shows that the older Pliocene fauna is lacking in the Central Plateau region of France, and the horizon of Perrier with the Mastodon bearing sands of Puy, of Coupet and of Vialette must be placed in the upper Pliocene not withstanding the total absence of *Elephas meridionalis.*

The fauna of Sainzelles presents the same characters as that of Perrier and can be considered only as a simple local sub-division of the same bed.

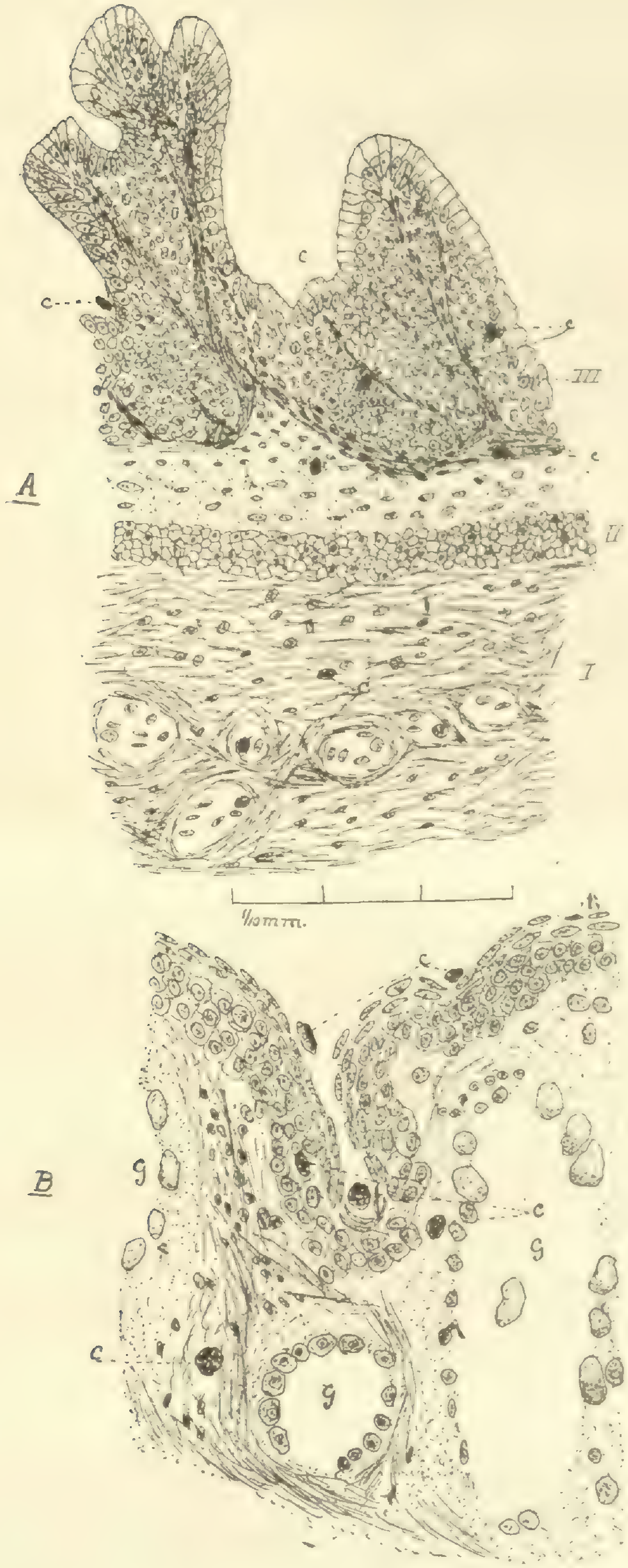
From these facts M. Deperet also concludes that the basalts intercalated in the gravels of Perrier and the Mastodon-bearing sands of Puy, and the breccias which accompany them, belong to the upper Pliocene, and, chronologically, are very near to the basalts of the Plateau. (Compte-rendu des Séances de la Soc. Geol. de France, 1893.)

Plistocene Diastrophism in the California Coast.—Mr. A. C. Lawson has obtained data which establishes (1) The uplift from the sea of the entire coast of California from San Francisco to San Diego, in Plistocene time, from 800 to 1500 feet. (2) A differential movement of the crust, to a remarkable degree, in the vicinity of Catalina Island, and near the city of San Francisco, also of Plistocene age.

The uplift changed the contour of the coast, which at the close of the Plistocene had had the aspect of an archipelago and was well supplied with harbors. The Channel Islands are remnant of the Pliocene condition, but the harbors have disappeared with one exception.

The orogenic movement resulted in the lifting of the Merced series, into its present condition and the upthrust of the Montara Mountain, which is described as having a central granite mass from which the strata of all ages dip quaquaversally. The mass antedates the oldest sedimentary strata on its flanks. In his conclusions the author states that the subdivisions Eocene and Neocene are not suited to the west coast of California. The reversal of the epeirogenic movement from a process of depression to that of uplift is believed to correspond

PLATE VII.



Sections of Stomach and Skin of Cryptobranchus.

with the beginning of the Plistocene, so there was no break in the marine conditions throughout the epochs, the Pliocene merging into the Plistocene. Between the Pliocene and Miocene, however, there was an important interval of erosion. (Bull. Dept. Geol. University of California, Vol. 1, 1893.)

Geological News.—PALEOZOIC.—Mr. M. R. Campbell's stratigraphical studies in Montgomery and Pulaski Counties in western Virginia, result in the establishment of two periods of disturbance in the Appalachian system. One folded the limestones and produced basins at the beginning of the Devonian period, the other elevated these basins and brought the period of sedimentation in them to a close near the middle of the lower Carboniferous period. These two periods of disturbance, in connection with other well established periods of overlaps show that deformation in the Appalachian system has been practically continuous since early Paleozoic time. (Bull. Geol. Soc. Am. Vol. 5, 1894.)

MESOZOIC.—Dr. J. W. Gregory describes two new species of Chilostomata (*Membranipora jurassica* and *Onychocella bathonica*) from the Jurassic beds of Normandy, France. This is the first description of Polyzoa of this order in the Jurassic. (Geol. Mag., Feb., 1894.)

From the evidence of fossil flora and certain stratigraphical facts, Mr. Benjamin Smith Lyman is inclined to put the Newark Brownstone at an earlier age than Mesozoic. Since the recent researches of Canadian geologists have proved that much of the so-called Trias of New Brunswick and Nova Scotia is really Permian and even Carboniferous, the author calls attention to the doubtful determination of the age of the beds in question, and suggests a thorough examination of the paleontological record in order to determine their position. (Proceeds. Amer. Philos. Soc. Vol. xxxiii, 1894.)

CENOZOIC.—The age of the yellow clay in the eruptive formations of Gravenoire, in which a human skeleton was found in 1891, has been fixed by MM. Girod and Gautier. A study of the stratigraphy and fauna of that region leads to the conclusion that the bed in question is a post-glacial deposit of the Reindeer age. (Rev. Scientifique, Feb., 1894.)

The collection of Bird bones from the Miocene of Grive-St. Alban, France, sent by Dr. Forsyth Major to Mr. Lydekker for identification, comprises six determinable species, of which four are new: *Strix sanctialbani*, *Palæortyx maxima*, *P. grivensis*, *Totanus major*. The

specimens of *Strix sanctialbani* confirm Mr. Lydekker in the view that the Strigidæ must be subdivided into the families Strigidæ and Bubonidæ. (Proceeds. Zool. Soc. London, 1893.)

According to Mr. F. L. Ransome, the eruptive rocks of Point Bonita, California, are differentiated into two formations which, from chemical analysis, seem to have been derived from the same basic magma. One is compact, amygdaloidal, does not show crystals to the unaided eye and is markedly spheroidal in structure; the other is distinctly crystalline, traversed by irregular joint planes, and is not spheroidal. The latter is intrusive into the sandstones and is, therefore, of later age. The spheroidal basalt was probably poured out anterior to the deposition of the sandstone and afterwards elevated to its present position. The author believes the spheroidal structure to be a flow phenomena. The lava issued in a viscous condition, one sluggish outwelling of lava being piled upon another to form the whole mass of the flow. The former center of volcanic activity, as indicated by the character and position of these formations, probably lay to the seaward at some little distance off the present coast. (Bull. Dept. Geol. Univ. of California, Vol. 1, 1893.)

BOTANY.[1]

Holophytes and Hysterophytes.—For some time I have been using in my lectures, and occasionally in some botanical writings which have not yet appeared in print, the two words here given.

Every botanist has felt the need of a word which should express what we mean when we say " a green plant," or a " chlorophyll-bearing plant," and he has felt even more the need of a single term to express what he means when he says a " parasite or saprophyte," a " parasitic or saprophytic plant," or a " chlorophyll-less plant." The terms I have used are not strictly new. We already have " holophytic " with precisely the meaning I would give this form of the word. Hysterophyte has often been used with nearly the meaning I would restrict it to, and its older use has practically become obsolete. The words may well be restricted then as follows: " holophyte," a chlorophyll-bearing plant, which is neither parasitic nor saprophytic, i. e., an independent plant so far as its nutritive functions are concerned; " hysterophyte " a chlorophyll-less plant, either a parasite or a saprophyte, i. e., a dependent plant so far as its nutritive functions are concerned. The etymologies are so evident that I need not give them here.

CHARLES E. BESSEY.

The Microörganisms of Fermentation.[2]—The name of Professor Emil Chr. Hansen is connected with a reform in the industry based upon fermentations. The reform is spreading all over the civilized countries, and it is gradually entering into the wine-industry, and, recently, into the manufacturing of vinegar. Hansen's principle is to work in the brewery with *pure yeast*, and this principle will doubtless be extended to other manufacturing trades the underlying causes of which are life-activities of microörganisms.

The famous Carlsberg Laboratory, where Hansen works, and from where the Kjeldahl nitrogen method sprung, could, a few years ago, not accomodate all of the students that came from all parts of the world. Consequently Hansen's collaborator, Alfred Joergensen,

[1]Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska,

[2]Joergensen, Alfred; Microörganisms and Fermentation. New edition, translated from the re-written and much enlarged third edition in German by Alex. K. Miller, Ph. D., F. I. C., and E. A. Lennholm, and revised by the author. With 56 illustrations. London, F. W. Lyon, Eastcheap Buildings, E. C., 1893. (pp. VIII + 257, 9x6).

established a laboratory for the purpose of giving specialists an opportunity of becoming acquainted with the new system, and, at the same time, supplying cultures to breweries. While Hansen worked mainly in the line of bottom fermentation, Joergensen worked with top fermentations.

All we who have had an opportunity of working with Joergensen, are well acquainted with his text-book ; it is as thorough as its author and as familiar to us as our catechism.

Chapter I treats of microscopical and physiological examinations in the line of lower cryptogams; Ch. II of examinations of air and water, including Hansen's zymotechnical analysis of air and water ; in Ch. III bacteria form the subject; Ch. IV contains the moulds, Ch. V (pp. 111–203) contains a full account of the alcoholic ferments, methods of analysis in this special line, and descriptions of the different species of Saccharomyces and their nearest relatives. In Ch. VI the application of the results of scientific research in practice (pp. 204–227) is set forth, and a bibliography and an index have finally been added.

Botanists are, as a general rule, too much absorbed by the questions of nomenclature, etc., to look into practical questions ; therefore, we often see, in text-books, very singular remarks on the subject of fermentations. A book like Joergensen's text-book should not be absent from any laboratory, chemical or botanical, because fermentations are subjects of study in both places, and because the work in these lines is very instructive, both to botanists and to chemists. To the special attention of all of these, the book of Joergensen is most cheerfully recommended.

J. Christian Bay.

ZOOLOGY.

The Cestodes of Herbivorous Animals.[1]—Dr. C. W. Stiles and Albert Hassall have issued a well illustrated list of the adult tape worms of cattle, sheep and allied animals. In this work the authors have had the great assistance to be derived from studying many of the original types. From this paper we learn that the domestic cattle are infested by 8 adult cestodes, the goat by 2, the sheep by 11, etc. The new species described are *Monezia oblongiceps* from a South American Coassus, *M. trigonophora* from sheep, and *M. planissima* from sheep and cattle. In connection with each species is a good anatomical description.

Cladoceran Crustacea.[2]—Prof. E. A. Brige, in the third of his "Notes on Cladocera," enumerates 63 species of Cladocera as having been found in Wisconsin and Northern Michigan. A table is given showing the distribution of each species in the lakes explored, and four plates illustrate the new or little known forms enumerated. The new species are *Moina affinis, Ceriodophina lacustris, Daphinia breviceps, Bunops* (n. g. for *Macrothrix serricaudata* Daday and *B. scutifrons* nov.) *Chydorus faviformis, Anchistropis minor.* A most interesting comparison is made between the Cladoceran fauna of Wisconsin and various regions of Europe.

Eyes of the Harvestmen.—Dr. Frederick Purcell has just issued an account of the eyes of the Phalangids[3] which is rather difficult to understand, on account of the absence of all illustrations. The Phalangids have two eyes which Purcell homologizes, without a doubt, with the median eyes of the scorpions. Like them, they are developed from three layers, the middle forming the inverted retina. The retinulæ each consist of five cells arranged in a circle and each retinular cell gives rise to a rhabdomere so that the rhabdom is five-parted and the longitudinal grooves on the outer surface of each rhabdomere give it a star-like section. The retinal cells are pigmented distally, the nucleus and nerve termination are in the proximal portions. Besides these there are club-shaped pigment cells in the dis-

[1] U. S. Dept. Agric., Bureau of Annual Industry, Bulletin, 4, 1893.
[2] Trans. Wisc. Acad. Sci. Arts, IX, 1893.
[3] Ueber den Bau der Phalangiden Augen; Dissertation. Berlin, 1894.

tal retinular region. The principal differences between these eyes and the middle eyes of the scorpion lie in the absence of a central cell, in the anatomy of the retinulæ and in the absence of inter-retinular pigment cells from the Phalangids. As a summary Purcell says: "The anterior middle eyes of the spiders, the eyes of Phalangids and the middle eyes of the scorpions, as well as the middle eyes of Limulus, represent a series of homologous structures, which are characterized by an inverted retina with retinulæ or at least rhabdomes."

Range of Placostylus.—A study of the geographical distribution of the land molluscan Placostylus, by Mr. C. Hedley, leads to some interesting conclusions. According to that author, Wallace's theory of a land connection between Australia and New Zealand is untenable. Mr. Hedley's theory is that the various islands where Placostylus is found, embracing the archipelagoes of Solomon, Fiji, New Hebrides, Loyalty, New Caledonia, Lord Howe and New Zealand, are the remnant of a continental area to which he gives the name, Melanesian plateau. This plateau was never connected with nor populated from Australia; its fauna was probably derived from Papua via New Britian. New Zealand and New Caledonia were early separated from the northern archipelagoes, while the Fijis remained to a later date in communication with the Solomons, but were severed from that group before the latter had acquired from Papua much of its present fauna.

The author calls attention to the fact that not the depth but the permanence of the ocean is the real limit to the distribution of the forms of life. (Proceeds. Linn. Soc. N. S. W., 1892).

The Scales of Lepidosteus.[4]—Mr. W. S. Nickerson finds that in *Lepidosteus* the dermal scleroblasts give rise to three different products: (1) calcareous scale material, (2) ganoine, and (3) a ganoine membrane. There is no differentiation of the cells, but rather a modification of the function of the same cells at different periods of their history. The ganoine has been called the enamel layer, but it is not enamel, as its development and chemical reactions show. It is secreted on the outer surface of the scale by cells of dermal origin, not by epidermal cells, as is the case with true enamel. The epidermal cells over it are unmodified and separated from the scale by a dermal layer of cells. Such a condition is found no where else among vertebrates.

During the development of the scale, spines tipped with an enamel layer are formed, but disappear before the maturity of the scale. Their number and irregularity of distribution over the scale opposes

[4]Bull. Mus. Comp. Zool., XXIV, No. 5 (1893).

the supposition that the ganoid scale is a number of placoid scales used together. There can be no homology between them except in their both being dermal structures. In the Selachians the basal plate originated in connection with the formation of spines, but in the Lepidosteus the spines have degenerated while the basal plate has developed independently at the same time sinking deeper in the dermis.

In the Telosts there is no ganoine, but a modification of the dermis takes place similar to that in *Lepidosteus*. The same sinking or a tendency to reduction of superficial parts and increase of the deeper parts, involving the reduction of spines. In the lower Teleosts the spines are connected with the scale by connection tissue only, thus showing a more degenerate condition than in Lepidosteus.

It appears, then, that the Lepidosteus and Teleost scales have been derived from the placoid scale along independent lines.—F. C. Kenyan.

Mammalia of Mt. Pocono.—Considering the fact that hitherto no systematic collecting of small mammals has been attempted in the Pennsylvania mountain districts the following notes may seem worthy of record. During the latter part of June and first week of July, 1893, in company with Mr. Witmer Stone, I spent about ten days collecting birds and mammals in the vicinity of Mt. Pocono, Monroe Co., Penna. The general situation and elevation of the locality warranted a much more northern fauna than that found in the southeastern part of the state, and it is hence not at all surprising that such boreal forms as *Zapus insignis, Evotomys gapperi* and *Tamias striatus lysteri* were obtained. None of these, so far as I am aware, have been previously recorded from Pennsylvania.

A list of the mammals collected is as follows:

Blarina brevicauda.—This shrew was the most abundant of any species noted; the specimens secured forming over 30 per cent of the whole number collected. I found them, as Dr. Merriam has said, moving about during the day, and on my afternoon visit to the traps rarely failed to secure one or more. Several were taken in the same runs with *E. gapperi.*

Sorex platyrhinus (Dobson).—Two specimens of a small shrew were secured which Mr. G. S. Miller, Jr. has kindly referred for me to this species, using the name as a provisional designation. A third specimen, badly decomposed, was found in the middle of a road through the woods. Of this the skull only was preserved.

Evotomys gapperi.—Five specimens of the red-backed mouse were

secured, of which four were taken in decayed stumps, and the fifth in a runway under a log.

Sitomys americanus.—A young male and female in plumbeous gray pelage, with a narrow streak of brown on the flanks were the only ones collected.

Arvicola pinetorum.—Two specimens were secured under a log.

Zapus insignis.—An adult male of this handsome mouse was secured July 4th, on the bank of a stream in a ravine covered with a growth of hemlocks and laurels.

Tamias striatus lysteri.—We found this chipmunk quite common among the rocks and young growths where the timber had been recently destroyed by fire. The specimens collected, on comparing them with skins from Maine, were found to be typical *lysteri.*

Sciurus hudsonius.—A tolerably common species. A suckling female, shot on June 29th, is an interesting specimen as showing a peculiar phase of the molt. The long winter coat is considerably bleached on the upper parts and sides; and from the nose to a line drawn across the head just back of the ears, npon the anterior margin and extreme tip of the ears, and for a space upon each shoulder it is entirely replaced by the new growth of shorter yellowish rusty hairs annulated with black. The bright chestnut of the dorsal region, besides being very much worn, is interrupted just behind the shoulders, by an irregular patch of the new hair, in which the black predominates. The sides of the head and neck as far forward as the roots of the whiskers, the greater surface of the ears, a space on the back of the head, and the entire posterior portion of the body still retain the old pelage.—Wm. A. Shryock.

The Mammals of Thibet.—Several French travellers have explored China, Mongolia, Thibet and Indo-China, and their reports are full of interest. Every naturalist knows of the brilliant discoveries made 25 years ago by M. l'abbé Armand David; they were revalations of the richness of the Thibetan fauna. Since that time M. le Dr. Harmand, M. Pavie, M. Joseph Martin, le prince Henri d'Orleans and M. G. Bouvalot, M. Dutreuil de Rhins and the French missionaries of Tatsi-en-lou, directed by M-go Biet, have contributed much to our knowledge of the natural products of central and eastern Asia.

The collections made by le prince Henri d'Orleans have been referred to the Museum d'histoire naturelle. They comprise a large number of mammals and birds, the former of which forms the basis of a paper by M. Milne-Edwards. The birds have been studied by M. le Dr Oustalet.

The fauna of Turkestan is very distinct from that of the Thibet region. The Tian-Chan mountains of Chinese Turkestan are inhabited by large quadrupeds very different from those of Europe: they are wolves bears, deer (*Cervus xanthopygus* A. M.-Ed.), roebucks (*Cervus pygargus*). Tigers and panthers from the south of Asia are seen there frequently. In the sterile and sandy desert which extends from Korla to Lob-Nor the fauna offers different characteristics; gazelles are abundant there (*Gazella subgutturosa*). They are seen in small troupes in the middle of those plains covered with a scanty herbage, and Tamarisks, where the only trees are stunted and twisted poplars, and where the river Tarim is lost in a great swamp. The color of the skin of these quadrupeds harmonizes admirably with that of the sand. The foxes are light yellow (*Vulpes flavescens* Blan.); *Gerbillus psammophilus* is common and resembles that of the Sahara; a cat (*Felis shaviana*) resembles in color and markings *Felis margaritæ* of the deserts of the northern part of Africa. Wild camels are found in small herds.

On climbing the slopes of the Al-tyn-Tagh, other animals are found: *Ovis poli*, *Pseudovis burrhel*, *Pantholops hodgsonii*, *Gazella picticauda*, wild Yaks with large diverging horns, covered with dark brown hair, *Equus kiang*, and numerous rodents.

From the Tengri-Nor to Batang the fauna is stilll more varied. The mountains, covered with conifer forests and thickets of rhododendron, afford shelter to many mammals. Travellers report seeing a black monkey with a long tail, which, however, they could not get near; but they captured several rhesus Macaques, remarkable for their large size, their long thick fur, and short tails. These animals, when adult, are comparable in size to the large Cynocephali of Africa; they live in large troops, are seen even in the midst of snow, and hide themselves among the rocks. The natives treat them respectfully and often feed them. A young female, bought in May, 1890, at Kiam Tatie, was sent to Paris, and is now in the menagerie of the museum. Although kept in a warm room, it has not the thick long fur to which it owes its specific name of *Macacus vestitus*. Neither *M. thibetanus* nor the snub-nosed monkey, *Rhinopithecus roxellanæ*, have been seen from Batang to Tsienlou.

Panthers and Ounces are abundant, also *Lynx rufus*; *Felis scripta* is also found here, and another species with a large body, belonging to the same group as *F. chaus*, but differing from it, which I have named *F. bieti*; *F. tristis*, which attains considerably larger dimensions than it is generally accredited with; *F. manul*, remarkable for the black

tint on its chest, and belonging to a variety named by Hodgson, *F. nigripectus.* Wolves are common, and Cuons with long reddish brown hair, probably *C. duchunensis;* Foxes, Skunks and Martens (*Putorius davidianus* and *Martes flavigula*); large bears, one black with a yellow pectoral spot, the other, brown, shading to bright yellow, identical with the one described by Fr. Cuvier under the name, *Ursus collaris. Arctonyx obscurus* A. M.-Edw. and *Ailurus fulgens. Ailuropus melanoleucus* is unknown in this region.

The Glires are represented by *Pteromys alborufus*, numerous squirrels (*Sciurus erythrogaster* and *Sc. fernyi*), *Tamias maclellandi*, *Arctomys robustus*, different species of Mus, a Siphneus distinct from those already known (*S. tibetanus*), *Lepus hypsibius*, the feet of which are colored red by contact with the ferrugineous soil, two species of Lagomys (*L. koslowi* and *L. melanostomus* Büchner).

The ruminant species are numerous. Wild Yaks, *Ovis nahoura*, and a species with compressed horns, believed to be new; *Pantholops hodgsonii*, a large Nemorhedus with a body like *N. bubalinus* of India, but having a long mane of white hair, and related to the species *Nemorrhedus argyrobhætus*, described by Père Hendes; two varieties of musk, Moschus, one gray-black in color, the other lighter, inclining toward yellow; *Elaphodus cephalophus*, the same species as that found in the valley of Moupin, but not quite so red; a roebuck similar to the one in the mountains Thian-Chan, but not so robust (*Capreolus pygargus*); a deer belonging to the group Rusa, but differing from the Sambur of India and Cochin China by its bushy tail which is longer and blacker, by larger ears, its muzzle bordered with black and its feet which are yellowish-white at their extremities.

It is astonishing that in such a short time the explorers could have collected such a large number of species. It is evident that fresh research in the same field will bring to light other mammals. Mgr. Biet, Bishop of Diana, and apostolic missionary of Thibet, has kindly given orders to have hunters sent in search of the animals along the upper Yang-tse-Kiang; but with these at hand, we see the resemblance between the animals of this part of Thibet and those of Indo-China, and we also note, at the same time, certain peculiar characters which are not found elsewhere. (Prof. A. Milne-Edwards in Proceeds. Cong. Internatl. de Zool, Deuxième Session à Moscow, 1892. Moscow, 1893.)

Zoological News.—Arachnida.—In two papers,[5] Mr. George H. Carpenter enumerates five species of Pycnogonids brought back by

[5]Sci. Proceed. Roy. Dublin Socy., VII, 1892: VIII, 1893.

Prof. A. C. Haddon from Torres Straits. Of these, three (*Parapellene haddonii, Ascorhynchus tenuirostris* and *Rhopalorhynchus claripes*) are new.

HEXAPODA.—The last number of the Kansas University Quarterly (Vol. II, No. 3, 1894) contains "New genera and species of Dolichopodidæ," by J. M. Aldrich, and "Descriptions of North American Trypetidæ," by W. A. Snow.

MOLLUSCA.—The molluscs collected during the United States Expedition to West Africa, in 1889–90, have been made the subject of a report by Mr. R. E. C. Stearns. In all there are 122 species, birds-it uted as follows: Pelecypods, 35; Marine Gasteropods, 69; Land Gasteropods, 82; Cephalopods, 5. (Proceeds. U. S. Natl. Mus. Vol. V, 1893.)

CHORDATA.—Balanoglossus has recently been found at Broken Bay and at Jervis Bay, New South Wales. The genus was previously unknown from Australia.

Prof. W. E. Ritter describes[6] a new Tornaria from California, the first indication of the existence of Balanoglossus on the Pacific coast of the United States. This Tornaria, like the Bahaman form, possesses tentacles on the longitudinai ciliated bands, and like the form described by Metschnikoff has a second circular band of cilia. In the oldest Balanoglossus obtained by the transformation of the Tornariæ, but two pairs of gill slits had appeared, and there is farther a thickened œsophageal band of epithelium which Professor Ritter would compare, in function at least, with the endostyle of Tunicates and Leptocardii. Lastly, the nerve cord does not arise by delamination but by a sinking down of the whole ectodermal nerve layer in a manner somewhat like that in Amphioxus. In the stages studied there was no trace of neuropore or neural canal.

An important collection of fresh water fishes from Borneo, examined by M. Leon Vaillant, extends the number of species now known from that Island to 322. M. Vaillant points out the strong resemblance of the fish fauna of Borneo to that of Indo-Malaysia. (Revue Sci., Feb., 1894.)

According to Mr. F. C. Test, the "Gopher Frog," *Rana aesopus* Cope, is subterranean in its habits, living in the burrows of the Gopher Turtle. It probably feeds on the insects living in the burrows, for these holes possess a flourishing insect fauna, to a great extent peculiar to them. (Science, 1893.)

[6]Zool. Anzeiger XVIII, 24, 4894.

EMBRYOLOGY.[1]

Experimental Embryology.—Two interesting pieces of work employing experimental methods have been recently published by Dr. T. H. Morgan. The first[2] appears to be but a preliminary account to be followed by more detailed illustration. The second[3] is complete and illustrated by figures drawn by the associated author Umé-Tsuda.

The former deals with the echinoderm—the latter with the frog-egg. In the sea-urchin *Arbacia punctulata* minute fragments of the eggs may be fertilized and undergo cleavage, but there is no evidence that fragments develop unless they have part of the female pronucleus. Hence Boveri's experiments[4] upon the cleavage of e-nucleated fragments are to be regarded with doubt.

When the eggs are pressed, after the method of Driesch, there is evidence that the place of formation of the micromeres is pre-determined, and not localized by intersection of the actual first and second planes of cleavage since it may be where the first and third furrows cross.

A repetition of Loeb's experiments[5] shows that the action of an increased strength of sodium-chlorid in the sea water is to stop not only the external but also the internal or nuclear phenomena of cleavage, contrary to Loeb's notion.

In the starfish *Asterias forbesii* it seems that shaking the eggs hastens the maturity processes!

The most remarkable part of the paper is the evidence pointing strongly to the conclusion that the eggs of the above star-fish may be fertilized by the sperm of the above sea-urchin, "two animals belonging to entirely different 'Classes' of the animal kingdom"!

In the second paper the vexed questions of the orientation of the embryo, the place and manner of closure of the blastopore and the related idea of concrescence are approached not only from direct study of living eggs but from the examination by sections and surface views of eggs that have been injured by needle-thrusts or modified, retarded, in development by action of certain salt solutions. Many important details hitherto overlooked are made plain and some interest-

[1]Edited by E. A. Andrews, Baltimore Md: to whom communications may be addressed.

[2] Anatomische Anzeiger IX.

[3] Quart. Journal Mic. Sci., Jan., 1894.

[4] See American Naturalist, March, 1893.

[5] See American Naturalist, April, 1893.

ing, but unsuccessful, experiments recorded in addition to these of immediate value. The general result is that the blastopore begins to form below the equator of the egg, in the white region, and closes in by a peculiar overgrowth from the dorsal lip, so that we cannot speak of a real process of concrescence of two lateral areas. The embryo is, however, formed along this region, that is upon what was the lower white side of the egg.

Embryology of Cyclascornea.—Heinrich Stauffacher has recently (Jen. Zeit., II Heft, 1893, pp. 196–246) studied in considerable detail the development and segmentation of the ova in *Cyclas cornea* L., in which the ova are developed in a single pair of follicles, the sperm in several pairs. The follicle is a simple tube lined with columar epithelium, surrounded by a homogeneous membrane. The primitive ova first appear as small spherical or elliptical cells next the membrane, among the bases of the cells of the follicle. The nucleus occupies almost the whole cell and has its chromatin rather uniformly distributed in the form of granules. As the ovum grows, it projects into the cavity of the follicle beyond the surrounding cells, but remains attached to the membrane by a constantly narrowing stalk. The egg membrane is formed only over the free projecting portion; the point of the ovum by which it is last attached by the stalk, persists as the micropyle. The ovum grows in part by the absorption of the surrounding cells of the follicle. Two Centrosomes were found in the mature ovum.

Stauffacher's description of the earliest stages of segmentation does not differ widely from Ziegler's account (Zeit. Wiss. Zoöl., Vol. 41). The egg divides into a small primary micromere and a large macromere. The former divides into right and left secondary micromeres, the latter into a second primary micromere and a macromere. This process is repeated, new primary micromeres being formed from the same side of the macromere, so that in these early stages, the secondary micromeres are arranged as right and left rows lying on the macromere.

Bilateral symmetry is shown from the first. During the resting period after the formation of the first primary micromere, the protoplasm of the micromere with its nucleus, becomes arranged around its free periphery, leaving a considerable cavity in the micromere next the macromere. As the second, third and fourth primary micromeres are formed, a cavity is similarly found in each. It disappears from each as the next primary micromere is formed, and is not present after the fourth.

The true cleavage cavity appears in the 13-cell stage. In the 16-cell stage two mesenchyme cells were found lying in the cleavage cavity, near the macromere, and Stauffacher thinks they are derived from it.

At about the 30-cell stage the last primary micromere is formed. Ziegler thought it formed the two large primary mesoderm cells, but Stauffacher thinks it enters into the formation of the ectoderm along with all the previously formed micromeres.

The macromere next divides into equal right and left halves. From each of these a large cell is segmented off into the cleavage cavity, one slightly before the other, agreeing with Rabl's account for Unio. These two cells last formed are the primary mesoderm cells. The two small remaining macromeres form the endoderm.—C. P. SIGERFOOS.

ARCHEOLOGY AND ETHNOLOGY.

Progress of Field Work of the Department of American and Prehistoric Archeology of the University of Pennsylvania.—Further search for proof of Man's great antiquity in North America has led to an exploration, in November, 1893, of the chalk gorges in southern Texas, where rumor reported the discovery of human relics mixed with the bones of the Mammoth and Fossil Horse. But the alleged sites of artificial hornstone chips and of human interments examined in the San Diego gorge, (Duval County, Texas), belonged not to the fossil-bearing layers but to a talus, which, mingling modern surface loam with ancient underplaced chalk, has greatly obscured the record of the freshet-torn ravine.

Further negative evidence, again illustrating the difficulties to be encountered in the search for human relics in the ancient layers of these parched water courses, was found in the deeper gorge of Indian Creek, near Berclair, (Bee County, Texas), which, like that at San Diego, had in recent years furnished shelter and stagnant drinking water to roving Indian bands. Here artificial chips and fire-fractured stones falling from the loamy crest of a fossil-bearing bluff lay not far from the teeth of the extinct American Horse in an indiscriminate talus below, while the clear, water-eroded cuts, exposing for more than a mile the stratification, (chalk and pebbles, marl and sand 6 to 18 feet and surface loam 2 to 8 feet), showed no human relic in situ to prove that Man in southern Texas had ever been the contemporary of the Mammoth, the Broad-Horned Ox and the Fossil Horse.

Turning again to the record of caves for the traces of Man as a possible predecessor of the Indian and contemporary of an older fauna in the Eastern United States, the dry, well-lit and easily accessible Cavern of Lookout Mountain, on the left Tennessee River bank, below Chattanooga, was examined in December, 1893. Four trenches, 6 feet wide and 5 feet 10 inches to 3 feet deep, dug twice to rock bottom across its floor, proved that Man had lived there. But they surprised us by showing the absence of distinct layers of occupancy separated by crusts of stalagmite, clay, sand or breccia, marking lapses of time between his comings and goings. Here, where the cave's shelter must have been forced upon the notice of primitive people by the narrowness of the river path and the height of the overhanging cliff, but a single bed of refuse, homogeneous throughout and showing no evolu-

tion in the form, material or grade of relics discovered, rested on the cave earth and limestone. No trace of "Paleolithic Man" or "Mound Builder," "Pigmy" or "Welshman" underlaid the familiar black band 3 feet 8 inches at thickest, that betrayed the well-known maker of shell-mixed pottery, bone awls, chert arrowheads, shell beads, drilled sandstone and clay pipes. The Indian, as known to the white discoverer, bringing with him a neolithic culture learned elsewhere, coming as high in the scale as he departed, and who had, as I found, laid the bones of his dead upon inner ledges of the cave and cast them dried and clean with arrowheads, potsherds, and broken perforated gorgets upon mortuary fires in a subterranean chasm 250 paces from the entrance, had alone inhabited the cave.

Paleontology would assert no antiquity for his occupancy as judged by the 29 living and 2 extinct species of fauna found with the refuse Some animals, traced by their bones in the fire places, like the Spade-Footed Toad, the Bat and the Tortoise, though the contemporaries or successors of the cave inhabitant, may have found their way into the midden heap to die, while the remains of the Unio, (7 species), Io, (2 species), Trypanostoma and Paludina, (2 species), and of the Catfish, Sucker, Drumfish, Land Tortoise, Water Tortoise, Soft-Shelled Turtle, Wild Turkey, Marmot, Lynx, Opossum, Squirrel, Raccoon, Otter and Deer, sometimes split and scorched, generally disassociated with teeth and but once showing traces of rodent gnawing, inferred the hunter's capture of food in river and forest and his carrying of larger animal trunks decapitated to the cave feast.

A bone of the extinct Peccary lying in the refuse repeated the discovery made in Queen Esther's chamber of Durham Cave, Pennsylvania. But the teeth of the Tapir (*Tapirus haysii*), and the lower ramus of an extinct Edentate of the family of Megatheriidæ kindly identified with all the other bones by Professor Cope, found by us in Section 5 (3rd foot) and close to the bottom of the layer of occupancy, added a new species and another genus to the list of (northwardly) extinct American mammals thus far observed in like association with human remains. Still we had not positively found that the Indian had met this gentle South American herbivore and an animal like the giant sloths Megalonyx or Mylodon, in the mountainous region of the upper Tennessee, for 1 foot 9 inches of the original red cave earth remained undisturbed and free from bones when examined, under the human refuse. The Tapir teeth and edentate jaw lying where found, near the bottom of the refuse and close to this lower stratum, may have been imbedded in the latter before the Indian came, so that if he

PLATE VIII.

Alca impennis L.

From The Dictionary of Birds.

encountered them in scratching his wonted oven hole he might have mixed them with what was to grow by degrees into the present fire-blackened layer.

The awe-inspiring entrance of the Nickajack Cave, (left bank of the Tennessee River, Marion County, Tennessee), though subject to partial invasion by river freshets that back the water of the cave creek several hundred yards into its channel, showed traces of aboriginal habitation as far as light penetrated. But the human refuse lay in a scattered talus on an uneven and craggy floor, about 250 feet wide, which, sloping steeply into the cave stream, was buried under masses of leached earth thrown upon it by nitre diggers in 1863–64. Where the remains of old fires were caught in hollows in the slanting ledge underlying this nitrous deposit, a trench (12 feet 10 inches long by 6 feet wide, by 2 feet 10 to 3 feet 5 inches deep), revealed again a single homogeneous layer of human occupancy continued on an undisturbed shelf clear of the nitre heaps and containing the remains of Unio (5 species), Paludina, Trypanostoma, fresh water Drumfish and Deer, and with its bone awls, arrowheads, chips, hammerstones and pottery repeating the record of the Lookout Cave. Again all trace of more ancient human presence betokened by underplaced deposits was wanting. Earlier peoples, if they existed, had avoided the Nickajack Cavern, and it is only pre-Columbian inhabitant had been the Neolithic Indian, who, strewing the alluvial meadows at its mouth with arrowheads and hornstone chips, had left potsherds, pebble hammers and a perforated ceremonial stone, along with the remains of the cave midden Mollusca and the Deer, Tortoise and Rabbit, at the river-side shell heaps a mile away.

Throughout the above investigation we have owed a grateful acknowledgement to the suggestion and kind encouragement and assistance of Professor Cope.—H. C. Mercer.

The Trenton Gravel Discussion has thrown light upon Man's antiquity in North America, but has not settled it.

We know that geologically, modern Indians chipped the rude leaf shaped outlines which we may as well call "Turtlebacks," but we do not yet know who else made them. The "Turtleback" exists without the Indian in Europe, and the more we study it the less—unhelped by associated evidence—we care to call it "Paleolith" or "Implement" on the one hand, or "Reject" "Unfinished Implement" or "Failure" on the other.

It was the quarry "Turtleback" of the pot making stone polishing Indian, that first fairly roused attention, and troubled us with the fear lest the Trenton "Turtlebacks" resembling it, had slipped down into the glacial gravels.

Some of the quarry "Turtlebacks" (viz., the spade like outlines from Garland Co., Arkansas), were big. Some (as the ½ inch long specimens from Macungie, Pa., and Flint Ridge, Ohio), were little. Some were made of pebbles (Piney Branch), some of native rock, some of Jasper, some (Gaddis' Run) of argillite, some were tolerably thinned before they left the quarry (Piney Branch and Flint Ridge). Others (Gaddis' Run) were not, some were leaf shaped, some rather triangular, others discoidal.

Still there was a family resemblance, and it seemed after examining thirteen American quarries east of the Rocky Mountains, that certain universal laws for blade chipping in the stone age had been discovered, for instance, that as the Indian quarrymen were yet Indians though they left no "Indian Relics" at the diggings, so the Drift Man (if he existed), though he left nothing but "Turtlebacks" in the Drift, might really have been a stone polisher and potter after all.

But to find arrowheads close by the pits at Flint Ridge, Macungie, and Saucon Creek, pitted hammerstones at Gaddis' Run, polished stone tools at Durham, and pointed wooden billets at Macungie, limited the ground for such inference, and as we may hope to find a rotting fuse or rusty iron drill under a heap of belgian blocks at a modern quarry, so there seems a chance of finding polished stone tools, arrowheads and pottery in the Drift, if the Drift Man made such things.

The fact that the Indians had quarried the stone, blocked it out into blade forms, rejected some of these, worked others into oft buried "blanks" and specialized the latter into spears and knives, seemed at first to indicate that an implement to be finished, and therefore to fairly represent the culture of its maker ought to be specialized. But the rule would not work always. The "Turtleback" was not the neglected brother of all chipped stone tools. What at Fort Bridger, Dakota, (as seen by Dr. Leidy in 1870) were serviceable implements (Teshoas) chipped by Indians from pebbles at a single blow, were at Washington quarry refuse chips. The flakes that were rubbish at Macungie and Flint Ridge, were hoarded together and carefully buried in Florida Mounds. If we went abroad we found in the Easter Island, knives, Admiralty Island, spears and Australian gum-mounted splinters, implements which were finished but yet unspecialized; and Mr. Ernest Volk showed us that "Turtleback" labelling might go wrong

at the very heart of the question where the ground seemed surest, when he found two hoards of rough argillite "Turtlebacks" which by all quarry experience ought to have been "rejects."

A whole new class of pros and cons were introduced into the study when we discovered in June at the argillite outcrop and indian blade quarry in the Delaware Valley, 20 miles above the hunting ground for the Trenton Turtlebacks; that there were two classes of Indian Turtlebacks—those of the quarry and those of the river-side. The evidence of these latter river-side specimens made from surface material, and that of Jasper pebbles found flaked by Indians at sea shore camp sites in New Jersey and Maryland, suggested strongly that "quarries" were comparatively modern and that rules of stone chipping derived therefrom would not cover the whole ground.

It seemed that the Indian must have been for a time a chipper of erratic stones on river beaches before the status of culture involved by quarries was reached, and that "Turtleback" work shops of what might be called a pre-quarry age, probably existed in the United States older than Flint Ridge, Durham, Gaddis' Run and Piney Branch, whose products remained to be compared with the alleged work in argillite of the Drift Man.

It was important to note that of the recorded argillite Trenton specimens, 29 were of this Delaware Indian "river-side" type, but against the case that one (Peabody Museum, No. 33,168, labelled as found 9 feet below the surface in the Penna. R. R. cut) had the stamp of the Gaddis' Run Indian quarry strongly upon it.—H. C. MERCER.

MICROSCOPY.[1]

Orienting Small Objects for Sectioning, and "Fixing" them, when Mounted in Cells.

I. In one of the recent "Contributions from the Zoological Laboratory of the Museum of Comp. Zoology," Vol. XXV, No. 3, Dr. W. McM. Woodworth describes a method of orienting small objects for the microtome. His method was developed, he states, from one first used by myself. To avoid any misunderstanding, I will say that in answer to a letter from my friend Dr. Woodworth, asking permission to use or describe my method, I replied that he was at liberty to make what use of it he saw fit, or words to that effect. I refer to the subject here, partly because Dr. Woodworth does not state what the original method was, or how he has modified or added to it, but mainly because I believe the original method is much simpler and better adapted to the purpose than his.

My method, which is especially useful when one desires to orient accurately large numbers of small and similar objects, is as follows:

Small strips of glazed writing paper marked with two sets of raised parallel lines running at right angles to each other are cut, and at suitable intervals a very small drop of thick collodion and clove oil, about the consistency of thick honey, is added. The drops are arranged close together along one of the ribs that run lengthwise of the paper. The object to be imbedded is cleared in clove oil, or oil of bergamot—not turpentine. The latter dries too quickly, so that air bubbles are likely to form in the object; and besides it does not mix readily, as it should, with the thick collodion. It is then raised on the point of a knife, and after the excess of oil is drawn off, transferred to a drop of the thick collodion. It may then be adjusted at leisure under the compound or the dissecting microscope, and will stay in any desired position.

When half a dozen or more objects are oriented in reference to the cross lines (which are to be parallel to the section planes) the whole thing is placed in turpentine. This washes out the clove oil and fixes the objects very firmly to the paper. When submerged in turpentine, if desirable, the relation of each object to the orienting lines can be redetermined under the compound microscope with greater precision than before. If any one of them has been inaccurately placed, it may still be moved to some extent, but it is better to note the fact, and

[1]Edited by C. O. Whitman, Chicago University.

make the necessary deviations from the section lines when that particular object is sectioned.

The paper with the attached objects is now placed in the paraffine bath, and finally removed and covered with paraffine in the usual way. After cooling in water, the block is trimmed and the softened paper peeled off, leaving the objects in the paraffine, close to the under surface of the block. This surface is now marked by the orienting lines of the ribbed paper and also by the record numbers, which, before imbedding, were written with a soft pencil on the paper. The block is now fixed in the microtome, and the objects cut one after the other, as though a single object had been imbedded; or a number of them may be cut together, if they have been arranged with that object in view. For example, we may use a thinner collodion, and arrange a large number of insect embryos, or small worms in a compact bundle, like a package of cigarettes, and cut them all at once.

Although I have not tried Dr. Woodworth's method, it seems to me that he has merely added to what is described above, several complications, which might in most cases be omitted. He gums the paper to a glass slide, dries it, covers the exposed surface first with a layer of gum and then with a collodion film, each of which must dry separately. The objects cleared in turpentine are then placed in position in the film which is softened and rendered adhesive by exposure to ether vapor, then slide and all are placed in the paraffine bath. Finally after imbedding, the slide is soaked in water to free it from the paper and the paper from the paraffine. In most cases I find it quite unnecessary to gum the paper, as it comes away from the collodion and the paraffine very well without it. It is, moreover, very inconvenient and unnecessary to imbed the paper attached to a glass slide in the paraffine bath. The paper alone can be handled with perfect ease, and it does not curl up or warp in the bath. If any warping occurs, I should say it was due, for obvious reasons, to the use of a collodion film in place of minute drops of collodion and clove oil. I should suppose also that any object of considerable size, say the egg of Limulus, could not be easily fixed in the manner suggested by Dr. Woodworth, for it is merely the adhesiveness of the small amount of turpentine on the object which must be depended upon to hold it in place. But as the turpentine evaporates rapidly, this would tend to free the object, or else fill it with air bubbles before the requisite number could be oriented, preparatory to softening the collodion in the ether vapor.

The advantages of the method, as I use it, are many; ease, rapidity (although we need not hurry) and accuracy of orientation; time saved

in imbedding and sectioning a considerable number of objects as one; and above all when many objects much alike are to be imbedded, there is no danger of confusion, since each one is plainly marked with its appropriate number.

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II. As every one knows, it is a great nuisance to mount under one cover, a large number of objects that tend to roll about into undesirable positions. It is often necessary to mount each one separately and then roll it about at great risk, till it is is just where we want it. And after all it is impossible to roll some things into place. I have used a modification of the method described above in mounting large numbers of objects under one cover, in perfect order, and in any desired position.

In mounting the eggs of Limulus, or heads of insect embryos, etc., I construct a cell of the requisite dimensions, and place in it small drops, close together in rows, of the thick collodion and clove oil. An egg is taken out of the clove oil, drained, and placed in a drop of collodion in the desired position. A great many eggs may thus be arranged like serial sections under one cover glass. Before adding the balsam, the slide is immersed in turpentine, which serves to wash away the clove oil and leave the eggs firmly fixed in the collodion.

The only precaution necessary is not to use too much collodion. It is surprising to find the small amount necessary, and the firmness with which the objects are held by it in place.

I have recently used, with a class of beginners, the above method of imbedding, with satisfactory results—merely as a matter of convenience in manipulating small objects easily soiled or broken in handling. Any glazed paper, or glazed tracing cloth will do, provided the collodion and clove oil is thick enough. The raised ribs may be replaced by fine black lines drawn with a soft pencil. These lines like the numbers are transferred to the paraffine when the paper is removed.

WILLIAM PATTEN, Hanover, N. H.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—January 13.—The Secretary read an invitation to attend the funeral of the Rev. Samuel Lockwood, of Freehold, N. J. Also the following extract from a communication by Mr. Ira K. Morris, which was adopted as the sentiment of the meeting, ordered spread upon the minutes and a copy transmitted to the family of the deceased:

It is with profound sorrow that we learn of the death of Professor Samuel Lockwood, of Freehold, N. J., on Tuesday last. By this sad event our Association has lost a very warm friend, and we shall feel most keenly the absence of his kindly encouragement and intelligent criticism. For years past he has taken a deep interest in all our proceedings.

Mr. Wm. T. Davis exhibited specimens of and read the following paper on Staten Island Harvest Flies.

Dr. Harris, writing of harvest flies, or locusts, in his "Insects Injurious to Vegetation," says of *Cicada canicularis* Harris:

"During many years in succession, with only one or two exceptions, I have heard this insect on the 25th of July for the first time in the season, drumming in the trees, on some part of the day between the hours of ten in the morning and two in the afternoon. It is true that all do not muster on the same day; for at first they are few in number, and scattered at great distances from each other; new-comers, however, are added from day to day, till in a short time, almost every tree seems to have its musician, and the rolling of their drums may be heard in every direction."

This *Cicada* is much less common on Staten Island than in Massachusetts, where Dr. Harris heard it sing so regularly on the 25th of July. It is plentiful, however, up the Hudson River, in northern New Jersey and in parts of Pennsylvania. On our Island its place is taken in point of numbers, by *Cicada tibicen* L., (*C. pruinosa* Say), a larger insect with a much more impetuous song. The species first appears about the second week of July, and I have recorded its song in the past as follows:

July 15, 1879, July 17, 1885, July 12, 1887, July 14, 1888, (three individuals), July 9, 1889, July 9, 1890, July 11, 1891, July 11, 1892.

Cicada tibicen L., also sings after dark on warm nights, but it is a lazy, languid song, as if the insect were tired, and it totally lacks the

impetuous vigor of the noon-day outburst. In the warm nights during the first part of August, 1887, it was no uncommon occurrence for this insect to give a short *z-ing*. Up to 8 p. m., they often sing, and I have heard a *Cicada* and a katy-did in adjoining trees. On Aug. 17, 1888, long after the sun was down, they kept up their songs, each one desiring apparently, to be the last singer, for their voices are raised in envy and the males have no love for one another. They often sing while flying about a tree in wavy lines, and once I detected another *Cicada* fly out of a tree and join the singer. It was no doubt a female.

They continue musical as late as the end of September, occasionally in considerable numbers I have heard them as late as October 3rd, both in 1885 and 1886. In the first mentioned year, they were exceedingly plentiful. When singing loudly the abdomen vibrates quite fast, but gradually lessens as the song subsides.

The dry pupa shells of this insect may be found attached to the bark of a variety of isolated trees, upon the roots of which the larvæ have apparently fed. On the 26th of July, 1889, at eighteen minutes to 5 p. m., I saw a harvest fly come from its pupa case. The legs (tarsi excepted) the prothorax and folded wings, were of a grass green color, the wings being particularly bright. The eyes were also green, the ocelli golden and the mesothorax and abdomen of a brassy appearance. In twenty minutes the wings were of full size, but flimsy, bending with the breeze. The wings were held out flat, on the same plane with the dorsal surface, when drying, and the genitalia are protruded.

The third and largest species of *Cicada* that has been found on the Island is *C. marginata* Say. The wings of a specimen, spread in the usual way, expand nearly five inches. This insect has also been taken at Yaphank, on Long Island, by Mr. A. C. Weeks; and Mr. Wm. H. Ashmead, who kindly examined my *Cicadas*, says that the insect occurs in Pennsylvania and about Washington. On our Island but one specimen has been found. It was discovered on a small post oak on a sand dune, near Mariners' Harbor, on July 19, 1892, while Mr. Beutenmuller and I were looking for galls. It was late in the afternoon and the insect had evidently but a short time before emerged from the pupa-case, which we found at the base of the tree. In the same summer a second pupa-shell was found on a black-jack oak, growing in dry sandy ground at Watchogue.

The only other harvest fly that has been collected on the Island is the red eyed periodical *Cicada*, or "Seventeen year Locust," of which a more detailed account, in connection with this locality, will be given at some future meeting.

Mr. Thos. Craig read a paper on A New Dictyosphærium.

In Wolle's description of this genus he describes the cells as green, and egg or kidney shaped, united in a globose hollow family, involved in a gelatinous integument.

He describes four species: *D. ehrenbergianum* Naeg., *D. pulchellum* Wood, *D. reniforme* Bulnh., and *D. hitchcockii* Wolle. The one under consideration does not agree in description with any of the above species. It was found along with other algae, tangled in the roots of water cress in a pond in the woods back of the Moravian Cemetery.

Mr. Walter C. Kerr exhibited a carefully prepared drawing of the trunk of a red maple tree and read a paper on Aerial Roots on *Acer rubrum, L.*

Near the brook flowing from Logan's spring swamp east of Silver Lake stands a red maple, about fourteen inches in diameter, and on its north side the bark has been stripped, probably by splitting from a wound received while young, forming a bare triangular space extending nearly across the base of the tree and having its apex thirty-six inches from the ground. The wounded bark has healed and its edges are covered with a smooth, gray, corky layer presenting the rounded appearance common to the edges of such scars. The wood being uninjured remains in a good state of preservation, while the entire tree is in vigorous growth.

It stands on a slight rise, about twenty-five feet south of the creek, in rich, rocky, moist ground, within eight feet of a low spot, which, though swampy in the wet seasons, is never overflowed.

The nearest trees are white oak and hop hornbeam, nine and fifteen feet distant, with no others within forty to fifty feet. Undergrowth is absent, and there is no reason to suppose that earth or stones have ever been heaped about it. It branches twenty feet from the ground and thus there are no conditions of darkness or exceptional moisture to encourage the development of aerial roots.

About six inches below and to the right of the apex of the triangular wound there springs from the cambium of the healed bark two roots, each one-half inch in diameter. They extend downward across the scar at an angle of about forty-five degrees; the upper being twelve inches and the lower seventeen inches long. They have decided root form and are covered with rootlets, the upper bearing about twenty and the lower about fifty.

The development of rootlets proceeds almost wholly from the lower surface of the roots, their length being from two to twelve inches, many being about six inches long, and all profusely branched, while

from the upper surface only a few stunted rootlets rise, sparsely branched. The whole appearance of these roots presents a strong contrast to the branches or young shoots of the red maple, leaving no doubt as to their character. Their tendency toward the earth is marked, though not reaching it by some eighteen inches.

What should cause these aerial roots is by no means evident, unless the scar has at some time been covered with a loose layer of bark under which the roots have grown. They serve no purpose and it would seem as though they could scarcely survive. As they are now alive, it seems best not to molest them for the purpose of determing their exact character and mode of growth until after further development has been observed.

Mr. Arthur Hollick presented specimens of fossil leaves from Arrochar.

Mr. L. P. Gratacap remarked upon a series of lower Helderberg and Hudson fossils, found in drift bowlders by Mr. Hollick at Arrochar. They included finely preserved specimens of *Spirifera perlamellosa* Hall; *Strophodonta beckii* Hall; *S. woolworthiana* Hall; *Strophomena rhomboidalis* Wahl.; *Cœlospira concava* Hall, and *Leptæna sericea* Sowerby, besides fragmentary remains of a *Pterinea* and bryozoöns.

Boston Society of Natural History.—February 7th.—The following paper was read: Prof. Edward B. Poulton: Theories of Evolution. A discussion upon the subject of Professor Poulton's paper followed.

February 21.—The following papers were read: Professor Charles R. Cross: Physics of color mixture, with experiments; Professor E. S. Morse: A recent advance in color printing by a photo-mechanical process.

Samuel Henshaw, *Secretary.*

New York Academy of Sciences, Biological Section, Feb. 12.—The following papers were read: 1. "The Morphology and Significance of the Variations of the Biceps flexor cubiti," by Professor Geo. S. Huntington. 2. "Our Conception of a 'Species' as modified by the Theory of Evolution," by Professor N. L. Britton. 3. "Reversal of Cleavage in a Sinistral Gasteropod," by Mr. H. E. Crampton, Jr. 4. "On the History of the Archoplasm in the Spermatogenesis and Fertilization of Lumbricus," by Mr. Gary N. Calkins.

Bashford Dean, *Rec. Sec.*

The Biological Society of Washington.—Feb. 10.—The following communications were read: Dr. C. Hart Merriam, A Remarkable New Rabbit from Mexico; Dr. C. W. Stiles, A Parasite of Man New to the American Fauna.

February 24.—The following communications were read: Mr. M. B. Waite, The Structure and Method of Opening of the Anthers of the Pomeæ; Mr. B. T. Galloway, The Winter Coloration of Evergreen Leaves; Mr. L. O. Howard, Further Notes on Spider Bites.

FREDERIC A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

From the Annual Report of the Essex Institute for 1893, we learn the following facts. The library has increased during the year by the addition of 3,317 volumes, 8,348 serials, and 7,416 pamphlets. These include the library of the late Dr. Henry Wheatland and the foreign exchanges of the Peabody Academy of Science, the libraries of the two institutions being now united. The total investments of the Institute now amount to $100,188.44, and the membership amounts to 325.

Giovanni Passerini, Professor of Botany in the University of Parma and well known for his studies on Aphides, died April 17, 1893.

Francis P. Pascoe, an English Coleopterist, died at Brighton, England, June 20, 1893, in his 80th year.

Dr. Robert Ritter von Schaub, who has studied the anatomy of the Mites, died in Vienna, Oct. 21, 1893.

Dr. A. K. Edward Baldamus, the ornithologist, died in Wolfenbüttel, Brunswick, Oct. 30, 1893, aged 81.

Robert Bentley, the botanist, died January, 1894. He was born at Hitchin, Herts, March 25, 1821. For many years he was professor of botany in the London Institution and examiner in botany to the Royal College of Veterinary Surgeons of England; lecturer on botany at at the medical colleges of the London, Middlesex and St. Mary's

Hospitals, and for twenty years dean of the medical faculty in King's College, London. For ten years he was one of the editors of the Pharmaceutical Journal. He wrote a "Manual of Botany," which has reached the fifth edition. He was the author of a series of manuals of elementary science, also "Student's Guide to Structural, Morphological and Physiological Botany." And was the joint author with Dr. Trimen, of a four-volume illustrated work on "Medicinal Plants."

Mr. E. B. Poulton, who has recently been lecturing in various cities of the United States, has been elected Hope Professor of Entomology in the University of Oxford, as successor to the late John Obadiah Westwood.

The summer school of Cornell University announces courses in Physical Geography, Geology and Economic Geology, by Professor R. S. Tarr.

The following appointments have been made at Cornell University. here. Mr. G. D. Harris, Assist. Professor of Paleontology and Dr. A. C. Gill, Assist. Professor of Mineralogy and Petrography.

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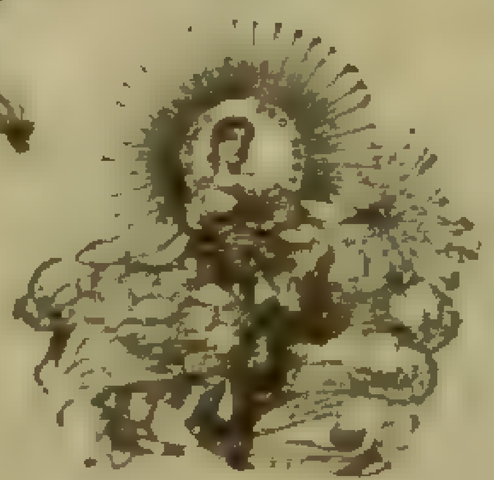

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AMERICAN NATURALIST

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REMARKS ON SCHULZE'S SYSTEM OF DESCRIPTIVE TERMS.[1]

By Alpheus Hyatt.

One cannot systematically describe a number of species or in fact properly record observations especially upon isolated species or groups without the aid of a convenient nomenclature and a generalized, topical scheme of work. The invention of such a system obliges one to make a more or less complete classification of the parts of any form, and this is a most efficient aid to thorough observation and a check upon hasty, inconsequent or unsystematic description.

Such remarks are apparently superfluous and even supercilious, but no one can work with new methods or try to find in scientific literature reliable data with regard to any of the invertebrates without being continually confronted with positive evidence that in the effort to place new species on record, many naturalists have lost sight of the main aim of descriptive work. The fixed habit of considering a new species as a discovery of such importance, that the describer's name must forever remain attached to it, is perhaps necessary, but it has loaded scientific research with an enormous mass of badly constructed records.

[1]This paper with the exception of the introductory remarks was published in Biologisches Centralblatt, XIII, Nos. 15–16, August, 1893, as Bemerkungen zu Schulze's System einer deskriptiven Terminologie. It has been thought advisable to have it published in English.

One of the most remarkable characteristics of the literature of this century in zoölogy and paleontology is the great contrast between the careless, inadequate, descriptive text of many large costly works and the excellent plates and other accompanying illustrations. There are a number of these books in which there is a wide difference between the scientific record made by the author and his artistic efforts or those of his draughtsman, the former being often inconsequent and unworthy of companionship with the latter. I refrain from giving examples for the simple reason, that they are within the experience of every student, and there would be no compensating advantage in exciting useless antagonisms. An attempt to construct a properly systematized topical scheme of work would have forced such authors to name and describe most of the principal regions and parts of the anatomy and to follow out a similar scheme in the description of each species, thus minimizing the irregularity and vexatious incompleteness of their observations.

One of the marked characteristics of the day in natural science is the effort to give greater accuracy to descriptive nomenclature. Professor B. G. Wilder[2] was the pioneer in America, and although his efforts were for many years unappreciated, they are now beginning to bear fruit. Wilder and Gage's Anatomical Technology (1882) laid the foundation of the movement which has just been reinforced in Germany by a very able paper from Franz Eilhard Schulze[3] in which he lays down some general principles for the construction of terms that ought to be carefully read by every naturalist.

The details of his scheme are in brief as follows:

He divides organic bodies into; (I) die Synstigmen, Centrostigma of Haeckel (*στιγμα* meaning point) having a single imaginary centre to the body. This point he proposes to call "centrum," parts in the centre "centran," approximate parts are "central" or "proximal," those which lie toward the cen-

[2]A partial revision of anatomical nomenclature, with especial reference to that of the brain. Science, II, 1881, pp. 122–126. 133–138.

[3]Bezeichn. d. Lage u. Richtung im. Thierkörper. Biol. Centralb., XIII, No. 1, 1893.

tre "centrad" or "proximad," those lying away from the centre "distal" or "distad," parts external or on the periphery "distan." Any part at right angles to the imaginary radii of the body or to the surface, he proposes to call "tangential" as long as they are external or "paratangential," when they are internal. Thus there may be tangential parts or distan, distal, proximal and central, paratangential parts, and they may be distal from the centrum or proximal when not central or centran.

Professor Simon Gage of Cornell in a letter to Dr. Wilder comments upon the use of "centran" as follows. "One of Schulze's principal points over what is ordinarily given is the suggestion of the termination "an" for the absolute centre, ventral surface, dorsal surface or aspect, etc. Barclay in his book, pp. 168–173, considers this and uses for this purpose the ending "en" as "centren, dorsen, dextren, sinistren," etc.

"The natural development of these ideas would have been to make a distinction between internal and external, using the termination "an" for internal parts which are centran or axian and leaving "en" for the designation of such as are peripheral. It is, however, evident as suggested by Dr. Wilder, that the termination "en" is more suitable for the designation of internal parts, on account of its derivation and common use, whereas "an" is in line with the terminations "al," "ad" and not in conflict with usage. It seems to me that Schulze is not wholly consistent in his use of the termination "an," and that following Wilder's suggestion, it would be much better to say centren and use centran for any external points which might be established in the polar axis of the body."

The class of bodies referred to as Synstigmen are to be found exclusively among Protozoa or their corresponding cellular elements among Metazoa, and Schulze's term is defective in that it takes no notice of the large numbers, especially among Infusoria, which have a spiriform arrangement of parts or of the entire body, often also more or less complicated with bilateral asymmetry.

Although it is obviously desirable that the assumption of an imaginary centre should be made in cases which have no

organic centrum, it will be considered questionable in the description of tissue cells or the bodies of the Protozoa, whether the nucleus should not be considered as the centrum. Schulze thinks that in such cases a distinction should be made and an additional compound term framed which would express the difference between the artificial and natural points or axis, etc. Thus the nucleus would be the "nucleo-centrum" however excentric its position. Undoubtedly in this, as in other cases, it is of advantage to make comparisons between the imaginary morphic centre and the organic centre, since while these are often the same they are not coincident in many forms and the use of a double set of terms will oblige observers to note such phenomena in their descriptions. Nevertheless one cannot say without experience in practical application whether a double set of terms would be advantageous or merely burdensome. (2). Die Syngrammen (γεαμμη meaning line) the Centraxonia of Haeckel, bodies elliptical cylindrical, etc., pyramidal, etc., which may be considered as having their parts arranged around an imaginary central axis but having all sides equal. This axis he calls "principal axis" both ends are styled "termini," the surfaces immediately around the termini are "terminan" and the direction toward them "terminad."

Centrum, centran, centrad, are used as before for parts lying in the principal axis or in that direction. "Axian" is employed for parts in the principal axis, when near to that line "proximal,"[4] when directed toward it "axiad," the region away from the principal axis is "distal," the direction is "distad" and the surface or periphery is "distan."

All planes or parts lying in planes going through the principal axis are "meridian," all parallel with these "parameridian." The parts lying in the plane passing through the centre at right angles to the principal axis are "transversan," and

[4]The use by Schulze of "proximal" as a synonym for "central" is open to serious objection. Proximal, proximad as synonyms of central, centrad, are not essential to his scheme, and these words are already in use as general descriptive terms applicable to any neighboring parts. It is, therefore, obviously disadvantageous to try to give them a more restricted meaning. The restriction of distal, distad, distans, to the body has similar objections and is not sustained by usage.

the planes parallel to this are "paratransversan." If the suggestion were adopted, all parts lying internally in these planes would be meridien and transversen, and the points on the periphery also in these planes would be meridian and transversan.

He intimates that there are oral and "aboral" planes in the paratransversan planes, but does not advocate the use of the terms oran, orad, and aboran and aborad as desirable for those bodies having the mouth in what may be called the terminan paratransversan plane, and the anus or base in the opposite plane.

Among Porifera one can assume a central axis, and it is possible to distinguish the oral and aboral ends or what may be considered as corresponding to them, the excurrent apertures (or so-called oral openings) and the attached base. But the incurrent apertures, the digestive sacs, the tissues and the spicules of the skeleton are normally arranged in concentric layers, which cannot be referred to any system of imaginary planes parallel with the principal axis. There is in these forms no organic element by which a meridian plane can be determined, they are exclusively concentric.

The same remarks apply also to the Hydrozoa and Actinozoa and more or less to all of the animals included under the old term, Radiata, whose parts are normally arranged in concentric layers cut by radiating lines and planes. If Schulze's system had taken note of such general morphic characters it would have been more complete. The meridian plane can be organically determined in most of these organisms, but this primitive division of the body is not carried out in the structures of the sides, these have no organic lateral parts which can be advantageously compared with any supposed parameridian planes. They and the tissues of the body all lie in concentric tubular conical or spherical surfaces secondarily intersected by radiating lines and planes. Schulze's system of planes takes no notice of these facts, but his meridian and transversan planes can be used with advantage to indicate the existing bilateral elements in these structures. The main objection to his system appears to be that it is better fitted for use among

"Bilaterien," that is for Mollusca, Worms, Myriapods, Insects and especially Vertebrates, than for the simpler organisms Protozoa, Porifera, Hydrozoa, Actinozoa, in which this element of symmetry is absent or more or less obscured.

Professor Wilder has already used "peripherad" as the antithesis of "centrad" and according to Schulze's system peripheran could be used for the distan surface in general. Thus the mesenteries of the actinozoa extend peripherad from the principal axis or the median plane.

It is also questionable whether a good topical classification of such animals as Actinozoa and Echinodermata ought not to recognize an intermediate region between the central and distal regions. There would be just as great a difficulty in defining a central region and a distal or peripheral one as in limiting the use of these terms to two regions separated by a third, which might be termed the extra-central with reference to the axis or extra-median when used with reference to the corresponding plane.

(3). "Die Sympeden oder Bilaterien," Zeugiten oder Centrepipden of Haeckel. These bilateral bodies have three axis. The "perlateral" axis is described as "isopolar" by Schulze, probably in allusion to the organic similarities of its poles. "Equiradial" would be equally good description on account of the equal lengths of the radii of the axis. The other is the dorso-ventral axis and is what he calls "heteropolar" and this is apt to be also inequiradial. The principal axis is the longitudinal axis, also described as "heteropolar" and apt to be also inequiradial, estimating from the supposed organic centrum. All in the principal axis is "axian," the neighborhood is "axial," the direction "axiad," or one may also use proximal, proximad, farther from it everything is "distal," and the direction away from this axis is "distad."

The two ends of the principal axis are respectively "rostral" instead of "cephalic" or "oral" or "proral" (Prora, prow of a vessel) and the tail end or the other end, whether distinguished by a tail or not, "caudal" instead of "aboral."[5]

[5] Schulze subsequently gave his nomenclature with illustrative figures in Verhandl. d. Anat. Gesellsch., May 1893, and Verhandl. d. deutsch. Zool. Gesellsch., May 1893. In this paper and in the discussion following this last a

The surface of the rostral end is "rostran" and the surface of the caudal end is "caudan." The direction toward these are respectively "rostrad" and "caudad."

In a letter from Prof. Gage to Dr. Wilder which has been forwarded to me, the former very justly observes that "Schulze discards 'cephalic' although he adopts caudal. Cephalic is certainly a more natural opposite of caudal than is rostral, the word he proposes in its place. Then cephalic has been and is used a great deal in English and considerably in German, and the use is increasing."

The main objection to this in my opinion, is that it applies to the vertebrata better than any other type and fails with the simplest forms of these. Among Ascidia, for example, there is perhaps a rostral extremity, but there is no caudal extremity in the adults. There is an aboral region, but the oral region is central or centran. While one therefore might make rostral, rostran and rostrad work well, some other term than caudal should be employed for the opposite pole. It seems contrary to all rational usage to employ terms having a definite meaning like cephalic and caudal to bodies that have no head, nor representative oral opening, and no tail.

Whenever in bilateral animals the mouth is at the extreme pole of the principal axis, I can see no objection to the use of oral, oran, orad, but when it is not there rostran, rostral and rostrad are highly appropriate. When the mouth is external and ventran, or lies out of the principal axis on any surface, as it is in a number of types, additional accuracy may possibly be given to the terminology if both rostral and oral planes or regions were recognized. At any rate this suggestion might be tested.

Schulze uses "dorsal" and "ventral" for the entire halves of the body respectively, the extreme surfaces are "dorsan" and "ventran," the direction toward them "dorsad" and "ventrad." The perlateral axis has "dextral" and "sinstral"

number of other terms synonymous with rostral and caudal, viz. atlantal and sacral, oral and aboral, proral and prymnal, actinal and abactinal were brought forward, even "Alpha ende" and "beta-ende" and the accompanying "alphal, alphan, alphad," "betal, betan, betad" were proposed for the two ends of the principal axis in bilateral animals.

halves, the ends are "dextran" and "sinistran,"[6] the direction toward them "dextrad" and "sinistrad."

The intersection of the axis is as before "centrum," the neighborhood "central," the direction "centrad." All the parts lying in the imaginary plane passing through the principal and ventro-dorsal axis are "median," the neighborhood is "medial," the more distant region on either side is "lateral." The direction toward the median plane is "mediad," direction toward the side is "laterad." Medial does not appear to be any improvement upon Barclay's term "mesial" or Wilder's modification "mesal" for the same plane. The latter in fact is preferable both on account of prior use and brevity. The extreme outer lateral parts or surfaces are "dextran" and "sinistran" like the ends of the axis, the direction toward these "dextrad and "sinistrad." Thus the two halves of the body are dextral and sinistral but the hands and feet are dextran and sinistran, the arms and legs extended dextrad and sinistrad of the dextran and sinistran surfaces of our bodies, and the right elbow is dextrad of the shoulder but mediad of the wrist.

This statement according to Wilder and Gage should be that "the right elbow is distad of the shoulder but proximad of the wrist," mediad and mesal being restricted to the trunk or used only for the general statements with regard to the limbs. Usage derived from Barclay would apply proximal and distal wholly to the appendages, distal being toward the free end and proximal at or toward the attached end. Wilder and Gage use these terms in this restricted sense and Comstock gives them an identical meaning. Butschli in the discussion quoted above in note also maintained that these terms should be applied only to appendages and parts outside of the mass of the body. That Schulze had no such limitations in mind when framing his terms seems to be settled by his suggestion to use proximal as a synonym for central, and

[6]Wilder and Gage use the term "aspect" in the same sense as Schulze words ending in "an," or Barclay's ending in "en"; thus there is the cephalic aspect and ventral dorsal, lateral and sinistral aspects. The strongest objection to these terms is the fact that they are not mononymic, whereas Schulze's terms fulfil this requirement.

his application of distans to the peripheral parts and the similar use of terms ending other in "an."

Comstock in his "Guide to Practical Work in Entomology"[7] says that dorsad, ventrad, cephlad, etc., indicate direction in parallel lines having infinite extension. "In other words these terms must be used in a way analogous to that in which we use right and left." Lines which converge according to small explanatory wooden model kindly sent me by Prof. Wilder, are described by him as "caudo-laterad" when directed from the head end to the sides, cephalo-mesad when in the opposite direction, "dorso-latero-cephalad" when diverging from the caudal extremity toward the dorsum and side and so on.

The plane passing through the principal and perlateral axis is termed by Schulze the "frontal" plane (a poor word as acknowledged by Schulze). This divides the ventral from the dorsal regions, but Schulze seems to get into trouble here and omits the usual list of terms for neighborhood. These must be dorso-frontal and dorso-frontad, very awkward terms and about as inconvenient as ventro-frontal or ventro-frontad. but dorsan, dorsad, and ventran, ventrad for the outer parts, come into line again without difficulty. It would appear more natural to designate this as the perlateral or lateral plane or the tergo-frontal plane. This would enable one to designate the neighborhood on either sides as frontal and tergal and the directions toward the plane as frontad and tergad, any part in the plane itself would then be tergo-frontans or frontens, etc. Tergo-frontal would not interfere with the normal use of these terms on either side of it and be also in accord with dorsal, dorsad and ventral, ventrad. for the ventral and dorsal regions respectively, and would designate the duplex relation of this plane passing as it does between two distinct regions of the body.

The third plane passing through the dorso-ventral and perlateral axis, is the "transversal" dividing the rostral from the caudal regions of the body; the parts lying in this plane are "transversan" and the direction "transversad"; rostral, ros-

[7]Ithaca, University Press, 1882, p. 9.

tran, rostrad, caudal, caudan and caudad also work well for the remoter parts. All planes lying parallel to any of these within the body are distinguished by the prefix "para."

Wilder and Gage have already recommended and now habitually use many of the terms also adopted by Schulze, but their system was tentative and did not aim at completeness. They, however, have used effectively "ental" and "ectal" terms not noticed by Schulze. Thus "the dura (mater)" is "ectad" of the brain but "entad" of the cranium. A part may be divided by cutting either ecto-entad or ento-ectad." There is also another application of words derived from ἐκτος and ἐντός which seems an obvious advantage. Ectal, ectans and ectad can be of great use if limited exclusively to parts that protrude from the surface of the body, like the appendages in Vertebrata, Crustacea, the spines of Echinoidea, the arms of Crinoidea, the tentacles of Actinoza and the like. Parts that stand out from the distan or terminan, rostran or caudan, dorsan or ventran surfaces of the body. If this were done the limbs would all be described as ectal of dextran and sinistran surfaces, the articulations of the body would be "ectad" or "entad" of those surfaces or their origin, if penetrating deeper might be designated by an appropriate term according to the topical terms already employed, central, proximal or distal. All the minor divisions of the ectal parts could then be referred to the surfaces of the body. Thus the bases of the spine in Echinus would be ectad of the body but proximad of its surface, while the termination would be distan with relation to the same surface, and it would have its own centrum and central region, principal axis, and so on.

In applying these words to a deeper seated part as to the radiating spines of Radiolarian or the threads of the stalk of a Hyalonema the use of "ental" to designate the part inside of the distan surface of the body would not entail confusion, since it would be used in direct connection with the description of the spine or threads. The stalk of Hyalonema in the most complicated example would be ental in origin, arising in the distal. It would be better to say the oral or actinal part of the central axis, pass through the centrum and

aboran regions and extend ectad, spreading out during its progress into a support suitable to anchor the body of the sponge in the mud below. The spines of Xiphacantha would be ento-ectal (extending from the centrum to the distans[7] surface and then ectad) having their origin in a central mass, possessing radiating spines on the distan surface and passing ectad of these to a variable distance.

Professor Gage objects to this in the following words "It seems to me the suggestions with reference to ectal, etc., are not happy. Proximal and distal seem to me to express nearness and remoteness of appendages to the part from which they arise. That may be reference to a limb or the trunk taken as the origin. For example, the arms and legs are appendages of the trunk, their distal ends being the hands and feet and the attached ends the proximal. So just as properly, in accordance with the established use of proximal and distal, the attached end of the hair is its proximal end while the free end is distal. This is true whether the hair is on the trunk or an appendage. I think the use originally made of ectal and ental by yourself (Wilder) the best one, the fundamental idea is in the compounds Ectoderm and Entoderm."

These criticisms coming from such a source and appealing to the derivation of the words are consistent with the Barclayan system and would be very convincing but for one thought that makes me hesitate to abandon this suggestion until I can learn more from experience. If the terms ectal and ental are to be applied to parts without reference to their origin, but simply because they are external and internal, it is obvious that they cannot be restricted any more than the words, outside and inside. If one is describing a spine or appendage of any sort the surface is ectal, the inner part ental, but if one is describing the body with reference to its appendages, the spines are ectal or they may have parts within the body and these are ental. The limbs of the Vertebrata and Crustacea may be considered either with reference to the surface of the body or to the skeleton, but the stalk of a hyalonema and the spine of Radiolarian may originate from the centrum itself.

[7] A better word here is peripheran.

THE SCOPE OF MODERN PHYSIOLOGY.[1]

By Frederic S. Lee.

A review of the present aspect and tendency of a rapidly growing science in the light of its history may not be without profit. It may help to clearer vision and more exact orientation; and it may direct and stimulate investigators. These thoughts, together with the prevalence of an apparent misconception regarding the true aim and scope of Physiology, have led to the following paper.

To one who is acquainted with modern biology, it will seem unnecessary to repeat that physiology is the science of function or action; that it is to be contrasted with morphology, the science of form or structure; that these two form the grand divisions of the science of living things, or biology; that, just as there is an animal and a vegetable biology, so there is an animal physiology and a vegetable physiology; that, further, every species has its physiology; that every portion of living matter, be it organism, organ, tissue, cell, or simplest group of molecules deserving the name protoplasm, Weismann's biophor, has its physiology; that, for whatever functions or acts, there must be possible a science of function or action. All this seems self-evident and trite to the biologist. By the non-biologist its truth is being overlooked constantly. To him, forgetting that botany and zoology exist, the term physiology means merely *human* physiology, a most narrow significance and one that is productive of evil results. Undoubtedly the animal physiologists themselves have been responsible, unintentionally and unwittingly, for this common and radically false notion of the relatively narrow field of their science. In their zeal to penetrate the mysteries of that most wonderful and most interesting of all protoplasmic structures, the human body, and in their desire to perfect a strong foundation

[1]Read before the Section of Biology of the New York Academy of Sciences, November 20, 1893.

for the science and art of medicine, it was to be expected that their investigations should have an "anthropocentric" bias and that physiology and medicine should be born and grow old together. Let a union so intimate be once established, let centuries of tradition surround and strengthen it and the separation is not an easy process. With special reference to this question and at the risk of treading upon well-known historic ground, what has been in brief the history of animal physiology?

It is convenient to divide it with Preyer into five periods; the first four ending approximately with the dates 350 B. C., 160 A. D., 1628, and 1837 respectively, the fifth extending to the present time. The last four periods are characterized by one or more prominent investigators, the second by Aristotle, the third by Galen, the fourth by Harvey and Haller, the fifth by Johannes Müller.

The beginnings of animal physiology were contemporaneous with the speculations of the earliest natural philosophers and the labors of the earliest physicians. In Egypt, in China, in India, in Greece, the origins of the science are necessarily indefinite and, with the help of occasional fragments of historical fact, must be left to our imagination. The inclination toward self-study is an innate human characteristic and the more obvious facts of man's bodily functions could scarcely have failed of notice. Something was doubtless learned from the bodies of men killed or wounded in battle, and from the slaughter of animals for food. More precise observations were made upon sacrificial animals for purposes of divination. But facts thus obtained were necessarily isolated, and abundant speculation was the distinguishing characteristic of the whole period. From its shadowy beginnings down to the death of Hippocrates and Plato, the theories that were held regarding the origin and nature of life, unsupported, as they were, by observation and experiment, could not establish a science of vital action. Even Hippocrates himself, skillful as he was in the treatment of diseases, was no physiologist.

At the beginning of the second period was Aristotle, the first systematic observer of natural phenomena. His knowl-

edge of physiological fact was derived, as is well known, in greatest part from his own observations on man, the lower animals, and plants; and to a large extent it forms the basis of all subsequent development of the science. His pupil, Theophrastus, founded the science of vegetable physiology. Contemporaneous with Theophratus was the development of the great school of medicine at Alexandria, and here, under Herophilus and Erasistratus, animal physiology, along with anatomy and pathology, as a part of medicine undoubtedly made great progress. The extent of that progress can be inferred only imperfectly from later writers. The loss of the Alexandrian records is most lamentable. Aristotle had dissected animals; the Alexandrians dissected the human body and, more important for our science if true, it is possible that they performed experiments on animals. The facts made known by Aristotle were added to; physiological material accumulated. Thus, while the first period had been speculative, the second was descriptive. But not yet was there a *science* of function.

Then came Galen, the great physician, investigator, and writer, and it was he who organized the mass of knowledge that through the centuries had been growing. From Galen's time animal physiology has had a recognized position as a branch of natural science. A modern writer[2] says of him: "In the midst of contending factions he alone and for the first time shaped physiology into an independent science. He established physiology as the doctrine of the use of organs: he experimented upon animals * * *; and he suggested questions which he answered by the aid of such experiments. In opposition to all his predecessors and contemporaries, he maintained physiology to be the foundation of medicine. Further, he, first of all and so far as it was possible at his time, described and explained the functions methodically and completely. Upon the one side he sought to refer vital phenomena to natural causes, and upon the other he lauded their purposeful character, with expressions of admiration for the wisdom of the Creator, while their fitness aided him in explain-

[2]Preyer, *Allgemeine Physiologie.*

ing them. * * * The fact that the Galenic physiology, wherever it was known, prevailed for fifteen hundred years is due to its two-sided development. For physicians accepted it because of its materialism, and the clergy because of its teleology. Since Galen was an extraordinarily sagacious thinker, an uncommonly learned man, an industrious, systematic, truth-loving worker and skillful physician, never neglecting practice for research nor research for practice, of all the medical fraternity he seemed best fitted to lay the corner-stone of physiology as a science in itself. And it testifies to his genius that, in the whole thousand years following him, Galen's physiological system, constructed through his originality and the power of his logic, endured as law, seriously opposed by no one. The history of no science can show the like. Faith in the authority of Galen's name finds its equal only in the history of religions." It is to Galen's influence, doubtless, more than to that of any other, that the intimate union of physiology and medicine, continuing even to the present day, is due. And to him likewise we must ascribe the present prevailing idea, already spoken of, of the essentially human character of the science. Galen's physiology was in essence a human physiology; and the new science fully born became the handmaid of medicine. Galen's authority was supreme until the age of the Renaissance, and throughout the long mediaeval period animal physiology was at a standstill. Toward its close the Italian universities were established and men began to think for themselves, to read nature in addition to the books, and gradually to learn that nature and Galen did not always agree. The elaborate and ill-founded hypotheses of the spirits, the elements, the qualities, and the humours did not accord with the progressive, investigating spirit of the Renaissance and rebellion against the master gradually grew in strength. Paracelsus burned in public at Basel the works of Galen. More destructive than fire were the anatomical investigations of Vesalius and Fallopius. And in physiology Colombo and Caesalpinus prepared the way for the most important single discovery of the times. This event, which more than all else demonstrated the ineffectiveness of pure speculation and the

need of a rational method of observation and experiment, was none other than the discovery of the circulation of the blood.

With the announcement of this to the world in 1628, what we have called the fourth period of physiological history begins. Harvey's book, "*De Motu Cordis*," is a model record of an ideal scientific investigation. The accumulation of an abundance of the essential facts, obtained by a most careful and systematic study of nature, the clear understanding of their logical positions and their mutual relations, and then, unhampered by scholastic systems and *a priori* considerations, but guided only by a regard for truth, the orderly arrangement of the accumulated material into the one possible rational system—such was Harvey's method. The result was incontrovertible. The full title of Harvey's work is "*Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus*," but Harvey himself, being a physician, and his contemporaries and followers naturally enough considered more especially the human bearings of the established facts. For two hundred years after, discovery followed discovery, and the permanent foundations of the various subdivisions of physiology were laid—circulation, respiration, animal heat, the functions of the central nervous system and of the peripheral nerves, movement, animal electricity, reproduction, optics and acoustics. Haller's well-known contribution was that of the independent irritability of muscle. Of perhaps as much value were his complete knowledge of physiological literature and his activity in writing. In 1747 he published a text-book, the "*Primae Lineae Physiologiae*," and in 1757 the large and complete "*Elementa Physiologiae Corporis Humani*." These books were widely circulated and the entity of the science was forever established. The title of Haller's larger work, "Elements of the Physiology of the Human Body," indicates that its "anthropocentric" character was stamped firmly upon it. By its independent growth, its subordination to medicine was, however, already weakened.

To enumerate its advances during the past fifty-six years, the fifth period, would be a task of great proportions. The

man to whom it is customary to give the credit for having outlined the path that was to be followed during his lifetime and for the generation that has elapsed since his death, the teacher, either personally or by his writings, of the veterans, Ludwig, Du Bois Reymond, Brücke and Helmholtz, was Johannes Müller. Müller's name will at once suggest the one important principle that he formulated, that of specific nerve energies, but his writings and discoveries cover a wide field. His extraordinary knowledge, energy, enthusiasm and stimulating power were all-important during a period so rich with biological achievements. It is perhaps a fair question, whether Magendie, with his marvellous activity as an experimentalist, may not dispute with Müller the honor of having given to the physiology of the past fifty years its characteristic trend. Certain it is that he fathered the science in France (Claude Bernard was his pupil); that his writings were read much across the Rhine; and that the labors of the Germans have been, like his, the collecting of facts rather than the constructing of systems. Within this half-century the establishing of the two great doctrines of physics, the mechanical theory of heat and its greater corollary, the conservation of energy, were of indispensable aid to the development of physiology. The idea of vital force had taken on many forms and the controlling principle of life had played its part under many titles. But, when it was shown that in the inorganic world the various kinds of energy are mutually interchangeable, physiologists, long hampered by and impatient under the old ideas, eagerly siezed upon the new, in fact, aided not a little in their discovery, and proved that they applied to living things as well as to the not-living—and, with this, freedom from unscientific speculation was won; the animal is a machine in a sense more complete than the Cartesian one. On the purely physiological side of biology, this is undoubtedly the greatest achievement of the present century. Until the substance of the plant and the animal body could be regarded as subject to the same laws that controlled all other matter, much must have remained mysterious and inexplicable and physiology could not be reckoned as all in all a

natural science. Psychology has always been hampered by the speculations of the system-loving metaphysicians. More actual fact and less conjecture are essential to the scientific method; and the scientific method is the method of progress. Following this freedom from the doctrine of vital force, physiology has developed actively along two main lines, the chemical and the physical including the mechanical, and is now often defined as the chemistry and the physics of living matter. An astonishing number of discoveries have been made, and the outlines that were sketched by Galen and Harvey and Haller and Müller and Magendie have been filled in with remarkable rapidity and completeness.

Let us consider for a moment the prominent characteristics of the work of this period. In the first place, Vertebrates have received more attention and have been the subject of more systematic investigation than Invertebrates. And among the Vertebrates, with the exception of the indispensable frog, which, however, is rarely regarded as a finality in research, the Mammals, being nearest to man have been most studied. Second, the number of forms used is very small; it is probably safe to say that the genera employed in four-fifths of the researches could be counted easily upon the fingers of the two hands. Third, adult animals have been used almost exclusively. Fourth, the study of organs has prevailed, i. e., the investigator has endeavored to discover the chemical, physical and mechanical laws by which the heart, the lungs, the glands, the muscles and the brain perform their respective tasks. These characteristics are the natural outcome of the birth and growth of the science. They indicate that, although the results accomplished are widespread and of the greatest value, there are left almost untouched still wider fields. The achievement of so much, however, along the lines of the past is stimulating to the student of to-day, for it has made possible the more rapid development of the science in the new directions, in which it is now tending. To these we shall return shortly.

I think that the historian of the present period will not fail to be struck by the comparative paucity of hypothesis in

physiological research, especially when our science is contrasted with the other great division of biology. It is as if men had been nauseated by the vitalistic doctrines and other wild guesses of the past and had resolved hereafter to hold strictly to the Baconian method. At the risk of being misunderstood and criticised, I cannot help feeling that this is to be deplored. The method of all physical science is truly observation and experiment; facts must be discovered and grouped and the laws formulated therefrom. But, in the search after facts, the inestimable value of hypothesis—of speculation, if you will—cannot be denied. It directs the searcher along a definite path and gives for the time being an encouraging and stimulating coherence to his results. If later his speculation becomes verified, well; if it proves false, its use is not to be deprecated, for it has served its purpose as an aid to discovery. The facts still remain, science is by so much the gainer, and with a new interpretation and a new hypothesis nearer the truth further advance will be made. The trouble is to keep the speculation within rational bounds and to know when to give it up. To employ it too sparingly is to retard scientific progress, and it seems to me that just here the animal physiologists of the present period are open to criticism.

Further, it is to be noted that until far into this period throughout the Continental, the English, and most of the American universities physiology and anatomy have together formed one department. At Bonn from 1826 to 1833, and at Berlin from 1833 until his death in 1858, Müller occupied such a common chair. Helmholtz held a similar position in Bonn from 1855 until 1858. Now, everywhere, animal physiology presupposes anatomy, and each science has its own field and its own methods. Further still, physiology usually occupies a place in the Medical faculty. This also is the result of its historical development. As I have shown, it is to the medical fraternity, more than to any other one class, that it owes its great progress in the past. But a glance at the literature of the present period will show that, largely through the efforts of its medical promoters, it has widely overstepped its early

medical boundaries. It has long since ceased to be a purely medical and anthropological science; it has become a biological science. Human physiology, like human anatomy, will necessarily always form one of the foundation stones of a medical training, and perhaps the most important one. But human physiology is but one branch of a science as broad as are the domains of protoplasm. Man's body is a machine, but it is a machine that has had a history. It is an achievement to learn to know the mechanical, chemical, and physical laws of this most complex of vital mechanisms. But the task of the physiologist does not end here—I should say it does not begin here. To know the action of the mechanism without its history is not only short-sighted, it is impossible. This is being recognized and a school of general and comparative physiologists is arising. During the present period, then, beside its great advance along the older lines, our science has begun a development along broader biological paths. It has won a place as an independent, pure natural science. More and more are its claims to admission to Pure Science and Philosophical faculties being recognized. It should be placed and will be placed by the side of chemistry, physics, and the morphological division of biology. I do not think it an exaggerated statement, that the tendency of biological thought at present is toward extraordinary activity along physiological lines.

(To be continued.)

THE ORNITHOLOGY OF NEW GUINEA.

By George S. Mead.

(*Mainly from the French of Meyners d'Estrey.*)

The Fauna of New Guinea shines almost exclusively in the variety and beauty of the birds, that are dispersed more or less over the islands surrounding the Papuan continent. Among these islands should be cited those more removed, such as Arrou, Adi and Sabouda, Misole, Salawatti, Batanta, Gagi, the isles of Gebe, King William and Waigeou as well as the principal islands of the great Bay of Geelvink.

It is calculated to-day that more than 400 species of birds belong to this region and it is probable that this number is very far below the correct estimate. The interior of the continent is certainly reserved for great surprises especially when we have become acquainted with the high plateaus of the country.

Of these 400 species, most numerous are those belonging to the families of parroquetts, kingfishers, flycatchers, honey-birds, crows, pigeons and herons. Others more rare, are representatives of the owls, sparrows, hornbills, bee-eaters, woodcocks and ducks.

Among the birds of prey, should be mentioned for its size—*Haliaëtus leucogaster*, which is found all through the Papuan Archipelago, especially the islands of Arrou; but it seems that it does not come to the Bay of Geelvink. The same is true of *Haliaëtus indicus*, while *Pandion haliaëtus* is met with everywhere. *Spizaëtus gurneyi* is the least common of all the birds of prey in the Indies and one does not meet it as a rule at Gilolo and the islands adjacent. Rosenberg obtained a specimen at Salawatti but did not see others.

Astur novæ hollandiæ is equally rare; Rosenberg killed one of these beautiful birds during his sojourn in Mefore. It strays as far as Java where occasionally it nests, and where the natives know it under the name of Tere.

Baza reinwardtii is seen everywhere, especially in gardens in the neighborhood of the huts.

The impenetrable forests under which the country is in some degree buried, serves as a refuge for certain kinds of owls, where it is difficult to take them on account of their solitary habits. Yet they are widely dispersed, and their peculiar cry is frequently heard in the silence of the night even near dwellings and in the center of villages.

New Guinea is par-excellence in Oceania the land of parroquetts. There are known to-day more than thirty species. Many occupy a wide extent of territory; for instance—*Cacatua triton, Microglossus aterrimus, Eclectus polychlorus, Trichoglossus hæmatotus, Lorius scintillatus, Nanodes placens* and *Nasiterna pygmæa.*

Others are confined to narrow limits: for example—*Lorius cyanauchen fuscatus, Nanodes musschenbrœkii, Psittacus brehmii et modestus, Psittacula melanogenia* and *Dasyptilus pecquetii.* The vertical dispersion of these species is very limited.

Microglossus alceto, Eclectus westermanii et *corneliæ,* as also *Lorius semilarvatus,* whose habitat it was supposed was in New Guinea, have never been seen there. It is surprising to find in the little island of Goram, near Ceram, *Cacatua triton,* whereas one might rather expect to see there *Cacatua moluccensis;* it is likely, however, that the former as well as the baboon *Cynocephalus niger* of Batjan, was brought originally to Goram and became wild again there.

Representatives of very many species of cuckoos are here met with; among them *Centropus menebeckii* and *sonneratii* are very common. *Cuculus leucolophus* and *striatus* on the other hand are quite rare.

Among the swifts that are found everywhere, two species especially should be mentioned, viz., *Cypselus mystaceus* and a Collocalia. We may name here also a large species of goatsuckers—*Podargus papuensis,* which inhabits chiefly the islands of Arrou, Waigou and Mefore.

New Guinea is extremely rich in sun-birds, as for example—the *Nectarinia, Ptilotis, Glyciphila* and *Melliphaga.* The large number of birds of this family as well as of the *Malurus* comes

from the blending of the fauna of the Moluccas with that of Australia which are united at it were in New Guinea.

Of the family of thrushes one meets here only three species of which *Pitta novæguineæ* is the most widely extended. The specimens which Rosenberg obtained from the isle of Sowek are different from the others in his account and have been described by Schlegel under the name of *Pitta rosenbergii.*

Flycatchers and analogous species abound in New Guinea and the adjacent islands. They are found without exception on the warm leeward coast.

One finds also frequently in these same islands many species of *Edolius* and *Graucalus* as well as *Eurystomus gularis,* which inhabits the entire Archipelago.

Artamus was not seen by Rosenberg either on the islands of Arrou or Misole, whereas *Cracticus cassicus, Tropidorhynchus novæguineæ* and *Lamprotornis* showed themselves everywhere in great numbers.

Of sixteen species of Kingfishers, *Dacelo gaudichaudii* is the most abundant; *Tanisyptera carolinæ* and *riedelii* are scarce. *Alcedo pusilla* and *solitaria* are quite rare, as well as *Dacelo torotoro.* All these birds frequent the leeward coast to the foot of the mountains.

One species only of hornbill is known in New Guinea—*Bucerus ruficollis.*

The family of Crows is well represented. Among them may be specially noticed *Corvusorru* with its bright-blue eye, and *Chalibaeus ater* of the color of steel.

The Birds of Paradise of which several species are known, are all from New Guinea, and the islands adjacent.

The distribution of some of these species presents some singular facts. One finds amongst others *Paradisea rubra* in Waigeou and Batanta, while at the same time it is not to be found at Salawatti, separated from Batanta only by the strait of Sagevien, which is is not very wide and which these birds could easily cross on the wing.

Paradisea papuana is not met in Salawatti, although this island is nearer the mainland (New Guinea) than Misole where it is said the bird is not lacking.

Paradisea regia is more widely dispersed, and *Paradisea apoda* much less so, for it is confined exclusively to the islands of Arrou. The former is found not only here, but in Misole, Salawatti, Jobi and the mainland.

Paradisea rubra haunts the islands of Waigeou, Gemien and Batanta.

Paradisea magnifica or *speciosa* makes its home in Misole, Salawatti and Jobi.

Paradisea wilsonii is found only in Waigeou and Batanta.

All the above mentioned seek the hot coast lands on the leeward side, while the two following keep at least 2000 feet above sea-level, viz.: *Paradisea sexpennis* and *Paradisea superba;* the latter is confined to the mountains of New Guinea solely.

Paradisea wallacei is found only in Halmahera and Batjan.

In the countries where the Birds of Paradise live, they constitute the bulk of the birds. The work of Wallace gives curious information concerning their habits and mode of life. Rosenberg also writes at length about them in his Notes of a voyage to the islands southeast of the Indian Archipelago. According to his statement the males and females of *Paradisea superba* were the first *undamaged* specimens of this rare species ever seen in Europe.

Epimachi (Plume-birds), species that vie in its plumage with the Birds of Paradise, are found only in New Guinea and Salawatti. Neither Wallace nor Bernstein was able to procure the *Epimachus speciosus* and *gularis* although the latter offered a reward of 80 francs for fine specimens.[1]

Epimachus magnificus and *resplendens* inhabit the mainland. The last is also encountered in Salawatti, in some places even in great numbers.

In Ternate Rosenberg met a traveller, who had brought a small collection of objects of natural history from the North coast of New Guinea, among them one bird in particular that attracted his attention. It was a new species unknown to science, the shape and tints of which resembled those of the female *Epimachus.* An offer was made by Rosenberg for the bird in order that he might secure it for the museum of Leyden,

[1] Confined exclusively to the Mountains of New Guinea.

but was refused. The specimen had been somewhat badly prepared and was not perfect. In compliment to Professor Veth, the savant who did so much to extend our knowledge of ethnology and geography of the Netherland East Indies, Rosenberg named the bird *Epimachus vethii.* Excepting the head, throat and neck the bird was of a brown color (*fuscus*); the upper part of the head was very dark; the back and upper side of the tail were ferruginous, the latter brown in the center. The breast was of a brownish-white, darker below and transversed by arched lines; the beak was curved and black. The length of the bird was about 35 centimetres, of which the tail made 14, the beak 7. The fourth plume was very long. D'Albertis and Meyer when later they visited the district of Arfak and other regions near the Bay of Geelvink, saw this bird which Sclater has named *Drepanornis albertisii.*

We find in Papua only four species of *Paradisiers Loriots,* viz. *Oriolus aureus* and *xanthogaster* that are confined strictly to the continent, *Oriolus flavicinctus* in New Guinea and the islands of Arrou, and *Oriolus striatus* in New Guinea, Waigeou and Salawatti. In museums there are scarcely any perfect specimens of these beautiful birds.

The *Gallinæ* are represented by only four families which, with the exception of the *Otidiphaps,* are found everywhere.

There are great numbers of Pigeons, forty species at least of which are known at present. Some of these are widely dispersed, others are confined to narrow limits.

Three species of Cassowaries live in these parts:—*Casuarius bicarunculatus* which is seen in the islands of Arrou; *Casuarius uniappendiculatus* found in Salawatti and on the northwest coast of New Guinea; and *Casuarius papuanus* inhabiting Arfak and the island of Jobi. These birds seek the flat hot lands but not the marshes.

Rosenberg describes a beautiful live specimen of *Casuarius uniappendiculatus* at Ternate, which was offered to him by the Rajah of Salawatti. This bird was about two years old and had nearly attained full growth although it still wore the brown plumage of its youth. The lovely golden shade of the neck which appears soon after birth, shone in full splendor but

the azure of the head was not so vivid. The bird was very tame, liking men but hating dogs and cats.

The Dromalectores, *Tallegallus* and *Megapodius*, are found everywhere excepting in the mountains.

The Waders frequent the coasts generally, particularly *Tringa* and *Totanus*. There are also many herons, especially in the Archipelago of Arrou, at the straits of Gallewo and in the island of Waigeou.

Aquatic birds are rare, excepting perhaps in Arrou; some species are *Sterna pelecanoides, torresi* and *dougalii, Podiceps gularis*; lastly the ducks, *Anas arcuata* and *radja.*

NOTES ON A SPECIES OF SIMOCEPHALUS.

F. L. HARVEY, ORONO, ME.

In a gathering from a spring swamp near Orono, Me., brought into the laboratory by Mr. O. W. Knight, one of my pupils, was found a fresh water crustacean in great abundance. The species is near *S. vetulus* Mueller, but as it differs in several points from the descriptions and figures of that species given by Herrick in his Minnesota Reports, the following observations, accompanied by drawings, are made regarding it.

The striæ in our specimens arise on the ventral margin from *triangular* or *quadrangular* spaces instead of *hexagonal* as stated by Herrick. See Fig. 4. These striæ are often anastomosing and lost in the dorsal region in fine reticulations. The prominence on the posterior part of the shell is variable; obtuse, or obtuse-angled and occasionally obsolete, and also variable in position. It is usually near the dorsal region but in one specimen it is located in the middle. It is always armed with blunt teeth, which extend above and below along the posterior margin of the shell. See Fig. 1. Head often concave in front, though in some specimens rounded as shown in Herrick's figures. Eyes placed near the end of the beak, round, bordered with circular clear cells and bearing on the front, six or seven circular facets darker than the general ground color. What is called the eye seems to be an eye spot bearing dark colored *ocelli*, reminding one of the eye spot of a *Thysanuran*. See Fig. 5.

Inferior antennæ fusiform, bearing in front a prominence armed with a stout spine, which is bulbous at the base and 90μ. long. The body of the antennæ encircled by about six rows of minute blunt teeth, one row of which adorns the distal margin. From the end arise two series of four slender setæ, bearing small bublets at the end. See Fig. 6.

Superior antennæ large. There are three short joints at the base which give great freedom of motion between the

long antennal joint and the body. The antennæ seem to us to be four-jointed below the rami, and this view is strengthened by the fact that in the young the three short basal joints are plainly marked. See Fig. 2. The third basal joint bears on the posterior a prominence armed with two slender spines. These spines show also in the young. See Fig. 2. The fourth, a long stout joint of the antenna, bears on the anterior distal end, a short spine 45μ. long. All the joints of the antennæ are ornamented with encircling rows of minute blunt spines, one row of which is located on the distal end. Rami of the antennæ *three.* The *outer* four-jointed, the basal joint short and unarmed, the second armed with a *short spine* and *not* bearing a *long two-jointed one as shown in Herrick's figures.* The two-jointed setæ arming the other joints of the outer and inner rami are *plumose* the *whole length* and *not naked below as shown by Herrick.*

Third ramus short, located at the base and between the others. Composed of *three* joints, *not two as stated by Herrick.* See Fig. 7.

The basal joint short and broad, the second joint fusiform, the terminal slender and hyaline. See Fig. 7.

The prominence in front of the anus armed with eleven spines, the anterior longest, all curving backward. Body back from the anus abruptly angled and *not gradually sloping* as shown in Herrick's figure. See Fig. 3. There are two long caudal spines at the posterior part of the body not shown by Herrick. See Fig. 3. At the posterior ventral angle of the shell are *four, not three, short stiff* setæ, differing from the slender plumose setæ forward. The setæ arise not from the *margin*, but a considerable distance above the edge of the shell and extend below it. The body of our form is much broader and deeper in relation to the length than shown in Herrick's figures.

In the body above the abdomen in most females were five oblong bodies. While examining one specimen, these bodies began to show motion, and soon were expelled as living young. One of these young is shown in Fig. 2. The eye was two-lobed and the body filled with spherules of a greenish brown color.

In all characters not mentioned, this form agrees with *S. vetulus*, Mueller. Whether the above differences can be explained by omissions and oversights by observers is not known. The sharp angle of the posterior part of the body, the caudal setæ, the reticulations of the shell, the plumose basal joint of the antennæ and the *three joints* of the third ramus of the superior antennæ are enough to characterize a new species near *S. vetulus* Mueller. I have a supply of alcohol and glycerine specimens, or can get living specimens another season, and will be pleased to send them to any one who has authentic specimens of *Simocephalus vetulus*, Mueller, for comparison, as I reluctantly make a new species of this form, never having seen *S. vetulus*, Mueller. We will be pleased to receive specimens of *S. vetulus*, Mueller from any one who has them.

Specimens varied in size from 1.5 mm. to nearly 3mm. Below is given measurements of a good sized specimen.

Measurements. Total length 2.67 mm. Total breadth 1.47 mm. Head from end of beak to where it joins the shell above, .785 mm. Sup. ant. .667 mm.—ratio of joints 10–1–4–3½–3½. Inf. ant. 140μ, including spines at the end—long spine in front 90μ.—terminal setæ 33μ. Eyes 107μ. d. Claws at post. end of body .3 mm.

Two setæ at post. part of body .38 mm.

Terminal setæ of ant. .59 mm. Reticulations on side of shell 35μ apart. Plumed setæ on interventral margin 115μ. Third ramus of sup. ant. 115μ, ratio of joints 2 : 5 : 7. Longest spine in front of anus 80μ.

Explanation of Plate.

Fig. 1.—*Simocephalus* species showing the general outlines of the female. (Original.)

Fig. 2.—The young immediately after birth, showing the two-lobed eye and the basal joints of the antennæ. (Original.)

Fig. 3.—The posterior part of the abdomen showing the angle back of the anus and the posterior setæ. (Original.)

Fig. 4.—The triangular reticulations on the the ventral posterior margin of the shell. The petagonal and quadrangular cells, that sometimes occur above the marginal triangular cells are shown. (Original.)

Fig. 5.—The circular eye spot with marginal clear cells and the dark colored ocelli upon the face. (Original.)

Fig. 6.—The inferior antenna showing the spine in front, the two series of bulbous setæ at the end and the encircling rows of teeth. (Original.)

Fig. 7.—Short three-jointed ramus at the base and between the two large rami of the superior antenna, (Original.)

EDITORIALS.

—THOSE who hold place in our municipal government are necessarily "men of affairs," and are very rarely possessed of the love of nature. Their idea of a tree is primarily based on its market value, but if it be necessarily ornamental by reason of its position, their idea of beauty consists in truncated branches with a coronæ of sprouts surrounding their extremities. Forest is in their view only attractive when it is cleared of smaller growth, and grass sown in its stead; and thickets of shrubs and vines are necessarily to be burned. Hills must be leveled, ravines must be filled up, and nature's slopes must be replaced by dressed stone walls. At all this the lover of nature rebels for various reasons. Such interference with natural processes produces utter poverty, and wood and field are robbed of one of their charms, variety. In a park which receives such treatment, where ten species of trees grew, but one remains. From the hillsides the native shrubs have disappeared, and on the open, which was once a bed of flowers, there remains but the monotonous grass, reduced if possible to a single species. Such treatment destroys the haunts of bird and insect, and lays open the few venturesome wild things that remain, to the persecutions of the rabble, who would never otherwise know of their presence. It is important that this official vandalism should never enter our public parks, or that it should be speedily suppressed whenever it shows itself. Our parks are for the instruction of the public as well as for their relaxation. Stone walls and graded paths abound in the city, and mutilated trees line the streets. Let the parks be pictures of the great nature with its energies untrammeled and its processes in view of every citizen who wanders in their shades or repose on their banks. Let its forest teach the lesson of decay as well as of birth and life, and *abeste profanes,* hands off, of wonders that man cannot imitate or improve upon.

—VOGUE is a form of automatism, and it is natural to man, since it is always easier to imitate than to create. There are vogues in naming, vogues in studying, and some other kinds of vogues to which naturalists are liable, as vogues affect other men of other professions. We are moved to these reflections by the observation of the vogue which has been enjoyed for three quarters of a century by the alleged adjective *madagascariensis.* From *Daubentonia madagascariensis* to *Megaladapis madagascariensis,* a long processon of *madagascarienses*

has filed into place in our nomenclature, there to remain until time and language shall be no longer. To account for this phenomenon we we cannot point viridically to the euphony of the word, nor to the great economy of time and space which we secure by adopting it. That suggestion and automatism have much to do with this custom there can be no doubt, but we venture a hypothesis which may relieve us of the painful suspicion that this ready yielding to ones subliminal self may be due to poverty of classical knowledge or inventive capacity, or both. The originator of the term foresaw the possibilities of the Malagassy language for cacaphony, so to avoid such terms as antananarivoënsis, and amboulisatrensis, he set the fashion at madagascariensis, and so it has remained. It is true that there are a few species of animals inhabiting the great island which are not named madagascariensis, but they must always remain in comparitive obscurity. But it might be well to place the name on the retired list in view of its eminent services in the past, especially as there some new aspirants to public favor which will give it a competition too serious for its years. The cacophony mill which produces Propalæhoplophorus and Brachydiastematotherium is still in motion, and we look for new revelations which will utterly destroy the usefulness of madagascariensis by placing it among the words of one syllable in the nomenclatorial primer.

—There is at present no law for the punishment of poachers in our National Parks. As a consequence the officers in charge can only escort men who are detected in this invasion of the rights of the public to the boundary, and there discharge them. As a consequence poaching has become rather a pleasant pasttime than otherwise. The recent detection of some men who have for several years been killing bison in the Yellowstone National Park, will perhaps stimulate Congress to remedy the evil. A bill is at present in the hands of the Committee on Territories of the House of Representatives which will if passed furnish the necessary legislation. We hope that nothing will prevent its early passage by both houses.

—We learn that the Sundry Civil Bill as sent to the House by the Committee on appropriations has not reduced the appropriations for the scientific work of Government bureaus below the amounts paid last year. We should be thankful for this in view of the extremely economic tendencies of the present congress.

—The legislature of Missouri is hesitating to make an appropriation for the continuance of the zoological survey. It will make a serious economic mistake if it fails to grant the usual sum.

PLATE IX.

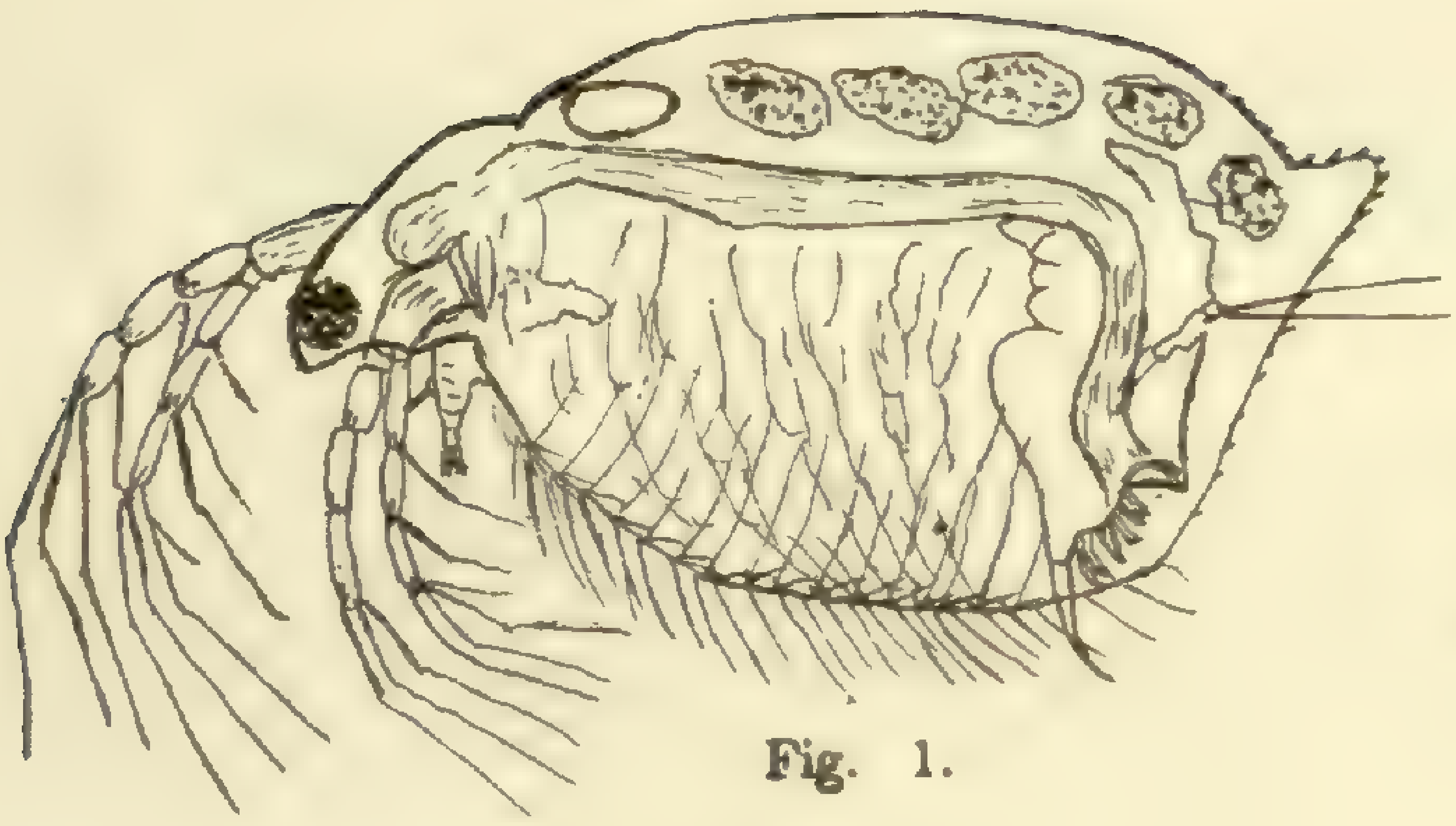

Fig. 1.

Fig. 5.

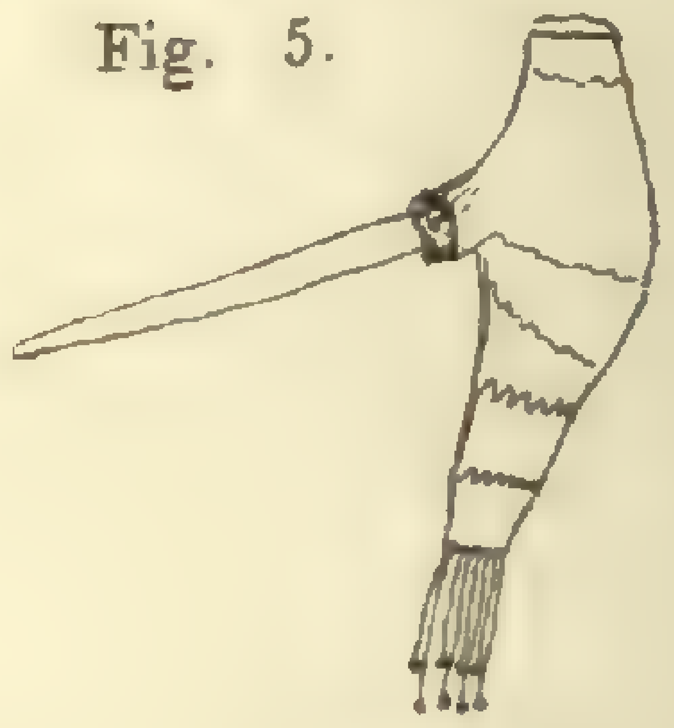

Fig. 6.

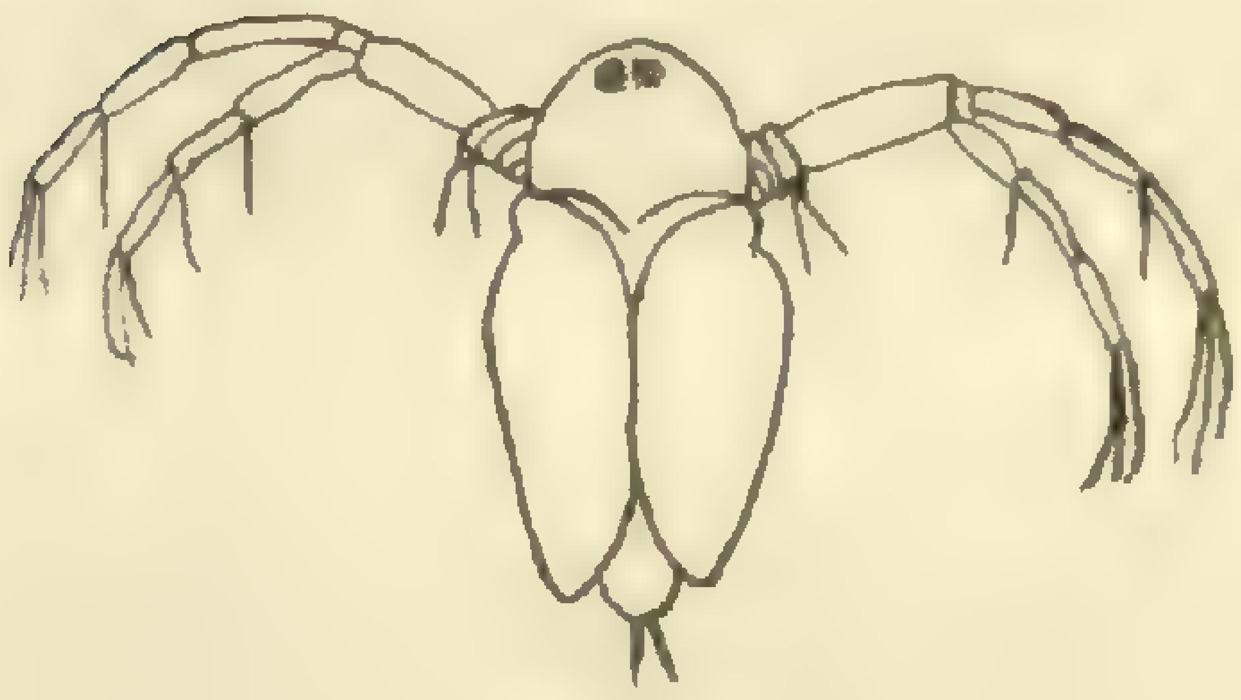

Fig. 2.

Fig. 3.

Fig. 7

Fig. 4.

F. L. Harvey, Del.

Simocephalus vetulus, Müller.

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RECENT LITERATURE.

On the Classification of the Myxosporidia, a group of protozoan parasites infesting fishes. (Art. 10, Bull. U. S. Fish Commission for 1891, pp. 407–420. Washington, D. C., 1893). By R. R. Gurley.

This paper is a communication preliminary to a more extensive report at present in manuscript. Several new terms are introduced, a new classification is proposed, three new species described and twenty species mentioned by other authors, but not named, are given binomial names. All of these species will be figured in the final report.

The new terms are as follows: *pansporoblast*, the plasma-sphere from which the sporoblasts arise; *sporoplasm*, the protoplasm of the spore; *capsular index*, the ratio of the length of the capsule to the antero-posterior diameter of the shell-cavity; *pericornual nuclei*, the two nuclei ("granules," "globules") at the antero-lateral angles of the sporoplasm or on the posterior extremities of the capsule.

Gurley's classification is based upon the symmetry of the spores as the most important taxonomic criterion and differs from Thélohan's classification in several particulars. Two orders with five families are recognized. One new genus (*Pleistophora*) is proposed; *Sphærospora* Th. and *Myxosoma* Th. are fused into a subgenus *Sphærospora* of the genus *Chloromyxum* Ming. The following key, based upon Gurley's tables and descriptions will show the plan of his classification.

Subclass *Myxosporidia*; pansporoblast produces—

I. Many (at least 8) minute spores, lacking distinct symmetry and possessing but one capsule — Ord. *Cryptocystes.*

- A. Spores numerous, inconstant; pansporoblast membrane $\frac{1}{n}$
  - a. Not subpersistent; myxosporidium present — Gen. *Glugea Th.*
  - b. Subpersistent; myxosporidium absent — Gen. nov. *Pleistophora.*
- B. Spores constant (8); pansporoblast membrane subpersistent; myxsoporidium absent — Gen. *Thelohania* Hen.

II. Few (2 at most) rather large spores with distinct symmetry and two or more capsules — Ord. *Phænocystes.*

Spores symmetrical bilaterally; antero-posterior symmetry $\frac{1}{n}$

- A. Present — Gen. *Cystodiscus* Lutz.

B. Absent; capsules in—
  a. Two groups, right and left wings; not bivalve — Gen. *Myxidium* Büt.
  b. One group, at anterior end; bivalve; capsules—
    α. Four — Gen. *Chloromyxum* Min.
    β. Two; inclination of plane of junction of valves to longitudinal plane
      *0°; vacuole present — Gen. *Myxobolus* Büt
      **90°; vacuole absent; sporoplasm unilateral — Gen. *Ceratomyxa* Th.

The family *Glugeidæ* includes the genera *Glugea, Pleistophora* and *Thelohania*; *Chloromyxidæ* includes *Chloromyxum* and *Ceratomyxum*, while the families *Myxidiidæ, Myxobolidæ* and *Cystodiscidæ*, each include but one genus.

As new species are described :—

1. *Myxobolus globosus* from branchial lamellæ of *Erimyzon sucetta*; globose, 7–8μ long by 6μ broad by 5μ thick; capsular index somewhat more than 0.50.

2. *M. transovalis* under scales of *Phoxinus funduloides*; 6–7μ long by 8μ broad; cap. ind. 0.50.

3. *M. macrurus* subcutaneous tissue of *Hybognathus nuchalis*; 10–11μ by 6–8μ by 4μ; tail 30–40μ; for further description see original.

The following species have been given binomial names :—

1. *Cystodiscus ? diploxys* from *Tortrix viridana*, vid. Balbiani, 1867.
2. *Myxobolus unicapsulatus* from *Labeo niloticus*, vid. Müller, 1841.
3. *M. inequalis* from *Pimelodus clarias*, vid. Müller, 1841.
4. *M. oblongus* from *Erimyzon sucetta*, vid. Müller, 1841.
5. *M. bicostatus* from branchiæ of *Tinca tinca*, vid. Bütschli, 1882.
6. *M. lintonii* from *Cyprinodon variegatus*, vid. Linton, 1891.
7. *M. obesus* from *Alburnus alburnus*, vid. Balbiani, 1883.
8. *M. cycloides* from *Leuciscus rutilus*, vid. Müller, 1841.
9. *M. spheralis* from *Coregonus fera*, vid. Claparède, 1874.
10. *M. perlatus* from *Gymnocephalus cernua*, vid. Balbiani, 1883.
11. *M. ? zschokkei* from *Coregonus fera*, vid. Zschokke, 1884.
12. *M. monurus* from *Aphododerus sayanus*, vid. Ryder, 1880.
13. *M. strongylurus* from *Synodontis schal*, vid. Müller, 1841.

14. *M. kolesnikovi* from *Coregonus fera*, vid. Kolesnikoff, 1866.
15. *M. linearis* from *Pseudoplatystoma fasciatum*, vid. Müller, 1841.
16. *M. schizurus* from *Esox lucius*, vid. Müller, 1841.
17. *M. creplinii* from *Gymnocephalus cernua*, vid. Creplin, 1842.
18. *M. diplurus* from *Lota lota*, vid. Bütschli, 1882.
19. *Chloromyxum mucronatum* from *Lota lota*, vid. Müller, 1854.
20. *C. incisum* from *Raja batis*, vid. Müller, 1851.

C. W. Stiles.

Stiles' and Hassall's Cestodes.—The publication by Dr. Stiles of several preliminaries, notably one in the *Centralblatt für Bacteriologie und Parasitenkunde*, 1893, No. 14–15, has led helminthologists to look with interest for the appearance of his revision of the Cestodes which has just been issued.[1] The letter of transmittal by the Chief of the Bureau calls attention to the importance of accurate knowledge as to specific limits, since "every separate species has a separate source of infection," and remarks truly that this paper "covers the results of a more thorough and extensive study of the tapeworms of cattle and sheep than has ever before been attempted."

Both authors are responsible for the bibliography and for the work on new species, Dr. Stiles, however, alone for the studies on species already known. The work is based on a careful and exhaustive study of internal anatomy, not only of our own forms, but also of the foreign species. In almost every instance the original types have been consulted with the result that now for the first time the character and limits of some of Rudolphi's species are known. In this connection the importance of preserving the type specimens cannot be too strongly emphasized. Dr. Stiles' experiments have shown that different methods of preservation result in such differences in external appearance and proportions, that no dependence can be placed on these data for specific determinations, the only safe generic and specific determinations are those based on internal anatomy. Careful study along this line has yielded unlooked for results. The topographical anatomy of the excretory system was shown in the preliminary already cited to be of great value in separating the genera in the family of the Tæniidæ and it forms the basis of the division employed in the present paper.

In the adult tape-worms of sheep and cattle, Dr. Stiles recognizes four genera:

[1]A Revision of the adult Cestodes of Cattle, Sheep, and allied animals. By C. W. Stiles, Ph. D., and Albert Hassall, M. R. C. V. S. U. S. Dept. of Agr., Bureau of Animal Industry, Bulletin No. 4, Washington, 1893; 103 pp., 16 plates.

I. Moniezia (Blanchard) which falls naturally into three groups:
   a. The Planissima group, with linear interproglottidal glands.
   b. The Expansa group with interproglottidal glands grouped around blind sacs.
   c. The Denticulata group, without interproglottidal glands.
2. Thysanosoma (Diesing), single uterus with ascon-shaped egg-sacs. Genital canals pass between longitudinal canals.
3. Stilesia (Railliet), for *Taenia globipunctata* and, provisionally, *T. centripunctata.*
4. Species inquirendæ.

In the special part of the genus Moniezia is considered first and most fully. Its three subgenera depend upon the presence and arrangement of the interproglottidal glands first described by Dr. Stiles. These are absent in one subgenus; in the second they form a deeply colored line in the stained specimen near the posterior edge of the proglottids, and finally in the third subgenus they are localized around blind sacs which open between the proglottids. For particulars of each species the original paper should be consulted; it gives under each a full synonomy with a valuable list of hosts and of the geographical distribution so far as known, a bibliography of the species, a historical review and a detailed account of the anatomy. This is followed by a specific diagnosis based on the anatomical description and a statement with regard to the collections in which type specimens may be found.

Among interesting details in the genus Moniezia may be mentioned that on the right side the vulva is ventral, the cirrus dorsal, while on the left the reverse position obtains. New are the species *M. planissima, M. trigonophora* and *M. oblongiceps.* The systematic position of *M. benedeni* and *M. Neumanni* does not seem to have been satisfactorily ascertained since the material at hand failed to yield good preparations; Dr. Stiles refers them, however, to the Planissima group.

By examining some of the original specimens from Rudolphi's collection, the exact limits of *M. expansa* (*Tænia exp. Rud.*) were determined. It is evident that most helminthologists have included more than one species in their descriptions. The old genus Thysanosoma (Dies.) is reestablished to include the form subsequently named by Diesing *Tænia fimbriata*, and *T. giardii* Riv. Of especial interest may be mentioned the presence of two transverse canals in *Th. actinoides.* The necessity of a new genus for *T. globipunctata* and *T. centripunctata* was pointed out by Stiles in his preliminary; meantime

Railliet had reached the same conclusion independently and formed for them the genus Stilesia. Its anatomy is discussed here.

Part IV, the discussion of species inquirendæ, is followed by a short half page on the life history, and two pages of general conclusions. Here is included a key for the determination of species. It is undoubtedly more difficult to use than those of Moniez or Neumann, and on that account will no doubt be criticized and perhaps disregarded by some; it is, however, more accurate and allows a determination of the species as well as the genus, which heretofore has not been possible. Part VII is a valuable compendium of species according to hosts with commendable cross references. In the addenda the fact of the gradual failure of the interproglottidal glands to stain as the material macerates, and the consequent possible identity of some species are discussed.

The bibliography given is very full and under each title is a word or two of valuable explanation. Yet it is on the whole the least satisfactory part of the paper. One could wish that the authors had used a better system of reference than by numbers; these differ of course in the bibliography of each species and in the general list, and the confusion could not but lead to mistakes. Had the year system been used, references would have been alike for all lists, and such an error as is noted on p. 32, where "my note (26)" refers actually to a book by Dewitz, would not have been possible. Apart from the system, however, some omissions are noted. Thus on p. 26, and again on p. 42, in the synonomy, Blainville is quoted "after Baird, 1853," but neither name can be found in the general or in the special bibliographical list. The same can be said of Mégnin p. 87. The habit of scattering references at the bottom of the page (p. 66), or through the text (p. 72), also seems open to criticism.

These are, however, but slight defects in a work which is on the whole so worthy of high praise. As the first scientific study of taxonomical helminthology which has been made in this country, is is fitting that it should have eminated from the zoologist of the Bureau of Animal Industry. It is, to be sure, purely scientific work; but its practical and economic value are correctly insisted upon by the Chief of the Bureau in his letter of transmittal already quoted. The Bureau is to be congratulated also upon the general appearance of the bulletin and especially upon the sixteen fine plates which are the work of its artist, Mr. Haines.

The Bureau does great service in offering to museums and private collections well preserved specimens of these tape-worms in exchange.

Of equal value is the exhaustive card catalogue of parasites and hosts kept by the Bureau. It is freely at the disposal of scientific workers, and by means of it one can refer to a desired species or to the entire literature on any parasite. Such an undertaking would be impossible save in the great libraries of the world, among which those at Washington are rated. Any one who, like the reviewer, has had occasion to refer to this catalogue, will appreciate its value and will join in wishing that such work may be long continued under the patronage of our Department of Agriculture.

HENRY B. WARD.

Clark's Microscopical Methods.[2]—This volume is hardly up to the times, being apparently the production of a man ignorant of modern methods of microscopical research. Thus we note an utter absence of any reference to such fundamental matters as serial sections, staining on the slide, the use of any fixing and hardening reagents except alcohol. We meet continually sentences like this " It is to be understood that the somewhat complicated processes of imbedding in paraffin and colloidin are not recommended for general use." We can say the same of the book.

Dodge's Practical Biology.[3]—To the long list of laboratory guides, the new year adds another. Professor Dodge has had considerable experience in teaching both high school (Detroit) and college (Rochester Univ.) classes and this work is the outcome of his experience. It is, as its name indicates, a guide to biology. It takes up first, the biology of the cell, treating of unicellular organisms and cells from the tissues of higher forms and then later, not in the sandwich manner but in the sequence which most teachers would adopt, takes up first the animals and second the plants. The directions for laboratory work are well and carefully drawn, and, a point which we note with pleasure, the student is told what to look for, not what he will find. He cannot answer the questions without recourse to the specimens, while the absence of illustrations renders it impossible for him to copy the diagrams in the book. Not only is structure studied, but, to such extent as is possible with the average student and with average facilities, the physiology as well.

[2]Practical Methods in Microscopy, by Charles H. Clark. Boston, D. C. Heath & Co., 1894, 120 pp., XIV+219.

[3]Introduction to Elementary Practical Biology. A laboratory guide for high school and college students, by Charles Wright Dodge. New York, 1894. 120 pp., xxiii, 422.

Aside from some minor slips of no importance, our greatest criticism would be that the work goes too much into detail, calling the students attention as strongly to minute points without any morphological importance as to those facts more pregnant with meaning. This, of course, is a minor matter where the student has a good course of lectures to accompany the laboratory work. It would be even less objectionable were there good text-books to assist him, but, as yet, the zoological text-book is a matter for the future.

Excepting this matter of lack of perspective which the student will in most cases be troubled with, we like the work and we feel confident of its adoption in many schools.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Geology of the Antartic Continent.—So little is known of the Antarctic polar regions that the résumé of facts given by Dr. John Murray, in a recent address before the Royal Geographical Society is of especial interest. Dr. Murray believes that there is abundant evidence of true continental land within the Antarctic circle, equal if not surpassing in extent the continent of Australia. Ross reports gray granite in the neighborhood of Victoria Land, and Dr. Donald secured some Tertiary fossils from the Seymour Island. D'Urville found both granite and gneiss exposed on an island near Adélie Land, while Wilkes describes an iceberg in the same locality covered with clay, mud, gravel, stones and large boulders of red sandstone and basalt, 5 or 6 feet in diameter. During the Challenger expedition fragments of granite and quartz were dredged from the bottom of the sea at the fortieth parallel of south latitude and as the vessel proceeded toward the Antarctic circle these fragments of rocks increased in number until they together with mineral particles and mud derived from land made up the larger part of the deposit. These fragment consist of granites, quartziferous diorites, schistoid diorites, amphibolites, mica schists, grained quartzites, sandstones, a few fragments of compact limestone, and partially decomposed earthy shales. They are distinctly indicative of continental land, and were undoubtedly transported by icebergs from the South Polar regions.

Among the numerous maps used by Dr. Murray to illustrate his paper is one showing the oceanic deposits around the Antarctic continent. Near the Antarctic land are the terrigenous deposits made of detritus from the continent. Glauconite is found in the blue mud of this area. A little to the north, the bottom is covered with a pure white siliceous deposit, the Diatom Ooze. Still further to the north, where the Diatoms on the surface have been replaced by Foraminifera and Pteropods, the deposit is a pinkish-white Globigerina Ooze. In latitude about 40° S. the sea is about 3 miles in depth, and here the deposit is composed of a fine Red Clay, manganese nodules, zeolitic crystals, spherules of extra-terrestrial origin, thousands of sharks teeth, and the remains of Cetaceans. In this red clay area a trawl brought up in a single hand over 1500 sharks teeth, some of them not to be distinguished from the

specimens of Carcharodon, found in the Red Crag of England. (Geog. Journ., Jan., 1894.)

Intrusive Sandstone Dikes in Granite.—During the summer of 1893, a peculiar sandstone rock composed of worn quartz grains was discovered in the neighborhood of Pikes Peak in the western side of the narrow Manitou park basin of sedimentary rocks. This rock occurs as the filling of an extensive system of fissures in granite under circumstances indicating that the sand was forced into the fissures under great pressure. Mr. Whitman Cross discusses the origin of these Dikes without, however, coming to any definite conclusion. So far as he is aware no other occurrence of sandstone dikes in granite has ever been described. They may be compared with the remarkable occurrences in California described by Diller.[1] These latter, however, were in shales of a great sedimentary complex of Cretaceous age, and they were parallel to a system of jointing planes in the strata. Moreover, Diller noted that below the horizons occupied by the dikes there occurred sandstone strata of a composition identical with that of the dike-rocks. The very plausible theory presented by Diller was that the fissures represented by the dikes were formed by earthquake shock, and that the sand was injected as quick-sand into the fissures under hydrostatic pressure from unconsolidated water-bearing sand layers below.

The Colorado dikes are more difficult to explain than those of California in that the known facts do not indicate the source of the sand; yet the physical and mechanical facts do seem to show that the fissures of this dike complex were filled by a fine quick-sand injected from a source containing a large amount of homogeneous material. On the one hand, it is impossible to suppose that such a system of fissures, large and small, with their many intersections, could remain open to be filled by any slow process, and, on the other hand, it is equally impospossible to believe that the uniformity and purity of the material filling the fissures, varying from mere films on cleavage planes of orthoclase grains in the granite to dikes several hundred yards in width, could have resulted from infiltration.

It has been stated above that the belt of observed dikes lies adjacent and parallel to the Manitou park basin of sedimentary rocks, the principal element in which is the red sandstones and grits of the Carboniferus (?) or Trias (?). These beds are, however, of much coarser and more heterogeneous character than the dike-rock, and the observations made do not suggest that the proximity is anything more than accident-

[1] Sandstone Dikes, J. S. Diller: Bull. Geol. Soc. Am., Vol. I, 1889.

al. It is not known that the dikes are younger than the sedimentary, for they were nowhere found in contact. The strata of the basin are now seen at the same level with the dikes, but faulting and a synclinal fold have clearly lowered them with reference to the granite on either side. Finally, it is probable that the dikes are not limited to the vicinity of the sedimentary basin. Neither end of the belt containing the dikes was determined, and an observation by Professor G. H. Stone shows plainly that sandstone dikes do occur in the same general strike line far removed from any sedimentary rocks. (Bull. Geol. Soc. Am. Vol. 5, 1894.)

The Origin of the Vichy Mineral Waters.—M. Dollfus has been making a study of the geology of the environs of Vichy and comes to the following conclusions as to the origin of the celebrated medicinal water of that region.

The waters charged with soda derived from the decomposition of porphyry percolate the earth in contact with carboniferous conglomerates and the Culm strata flowing in a synclinal. When their downward course is checked by the granules or the micropegmatites which are impermeable, they reascend through the tertiary beds. Here their flow is partially impeded by the arkose beds which are topped by the Cusset Marls, and an immense water sheet is formed near the contact of these two formations. Atmospheric waters are here the important factors, and the carbonic acid gas with which they are charged becomes an active agent, displacing even the silicic acid of some of the feldspathic compounds. In short the alteration is set up at the surface; decomposition and kaolinization of the porphyrites goes on, under our eyes, at the surface, for, below we see compact, unaltered rocks, in which no chemical activity is apparent.

The origin of the carbonic acid is more difficult to explain. Since the atmospheric waters do not furnish a large enough supply, some of it, as well as the lime, must be derived from chalks of Vernet and the water-bearing marls of Cusset. The phorphyritic strata are limited around the Central Plateau; the presence of granite, covering of impervious clay, an abundance of lime, and all the peculiar series of conditions which are met with at Vichy and no where else, explain the formation of these peculiar mineral waters and their isolation in the midst of hydraulic basins of which the products are so very different. (Rev. Sci. Mars, 1894.)

Metamerism in the Skull of Primordial Palæozoic Fishes.—One of the most interesting of recent discoveries is that by Dr. J. V. Rohon[1] regarding the fossils fishes of the genera *Thyestes* and *Trematas-pis* from the upper Silurian strata of the island of Oesel. Both genera belong to the order Aspidocephali. In *Thyestes* the cartilaginous primordial cranium falls into two distinct regions, anterior and posterior, the former of which is bilaterally segmented, the latter not. On each side of the anterior region five segments are recognizable, the proximal being joined to the middle skull mass, the distal portions being discrete, more or less pointed and arched behind. In the region of the second and third segments is the median frontal organ, between the third and fourth is the well marked optic capsule, while the parietal organ is above the fifth segment and between it and the hinder region of the skull. The hinder portion, representing the occipital region, is in form much like the body portion of the skeleton. Ventrally to it are apparently the remains of gill arches. Labyrinth and jaw apparatus are not differentiated.

From these facts Rohon concludes that the Aspidocephali cannot belong to Cyclostomes, Selachians, Ganoids or Leptocardii. They must belong to a distinct subclass for which he proposes the name Protocephali. The paper is a preliminary one and the complete article with plates will be awaited with interest.—K.

Mr. Rohon does not explain what he understands by the term Aspidocephali. The genera Thyestes and Tremataspis have been hitherto included in the family Cephalaspidæ of the order Osteostraca of the subclass Ostracophori of the class Agnatha. M. Rohon's observations show that this systematic arrangement needs no modification, except that the genera Thyestes and Tremataspis must be separated as a family distinct from the Cephalaspidæ.—C.

The Auriferous Slates of the Sierra Nevada.—In a recently published paper, Mr. J. P. Smith reviews the opinions of previous writers as to the age of the auriferous slates of the Sierra Nevada, and after giving a brief statement of recent discoveries and determinations of fossils from the beds in question, embodies the results of his investigations in the following conclusions:

"The Auriferous slates are known to consist of Silurian, Carboniferous, Triassic and Jurassic strata."

"The Mariposa slates are of Upper Jurassic, probably lower Kimmeridge age."

[1] Zool Anzsiger XVII, p. 51, 1894.

"The uplift and metamorphism of the Sierra Nevada and of the Coast range occurred in late Jurassic time, before the deposition of the Cretaceous."

"Neumayer's theory of climatic zones cannot be applied with exactness to the Jura of California, which can be understood only by the study of the geographic provinces of that time." (Bull. Geol. Soc. Am. Vol. 5, 1894.)

Comparison of Jurassic and Upper Cretaceous Trituberculates.—In a paper on upper Cretaceous Mammals, Prof. Osborn makes the following comparison of the Laramie mammalian dentition with that of the earlier Purbeck, and of the later Puerco.

"In the Laramie the modern placental or marsupial dental formulæ are established—the teeth behind the canine are usually seven, and do not usually exceed eight. Marsh observes in one jaw what he considers five premolar alveoli. Second, out of the high crowned upper molars of the Jurassic, such as those of *Amblotherium* and *Spalacotherium*, a relatively low-crowned or bunodont tritubercular molar has been evolved; as this is a possible parent form of the ungulate and primate upper molars, it is an essentially Tertiary type. Third, the lower molars have evolved a broad talonid or heel, which in many cases presents three cusps, whereas in Jurassic types the talonid is a spur or a narrow simple basin. Fourth, the trigonid, which is always very elevated in the Jurassic types, sinks in some cases to the level of the Talonid—another modernization looking toward ungulate and primate ancestry."

"Two features make the Laramie fauna appear more ancient than the Puerco: first, the non-development of an internal cingulum, which is common in the Puerco; second, the entire absence of the hypocone, which is quite strong in some Puerco mammals. On the other hand, the upper and lower molars of Types represented in figs. F, G, I, Cl, respectively, are analogous to Ectoconus, Dissacus, Diacodon, aud Haploconus of the Puerco."

"The zoological affinities of this fauna are at present hard to determine. *Ptilodus* and *Meniscoëssus* are still provisionally referred with the Multituberculates to the Monotremes. *Thlæodon* exhibits a jaw without an angle, and with a surprising resemblance to that of *Polymastodon*; the jaw is certainly neither of the typical placental nor of the marsupial type; this animal may therefore be provisionally considered a trituberculate Monotreme."

"The placentals and marsupials, and the question whether one or both of these orders is represented in this fauna, is still unsettled. Not a single jaw has been found or reported sufficiently complete in the delicate region of the angle to determine positively its placental or marsupial structure. Portions of the jaws which are preserved indicate the presence of the marsupial type of inflection, while others point to distinct placental angulation." (Bull. Am. Mus. Nat. Hist., Vol. 5, 1893.)

Ancestors of the Tapir.—In describing two new species of Protapirus, *P. obliquidens* and *P. simplex,* from the Lower Miocene of Dakota, Messrs. Wortman and Earle take occasion to discuss the phylogeny of the Tapiridæ and thus summarize the points brought out by the descriptions:

"1. We consider the genus Systemodon as standing in ancestral relation to the Tapiridæ.

"2. *Isectolophus latidens* is probably the line leading to the true Tapirs.

"3. If further discovery shows that *I. annectens* has both the last two premolars as complex as the true molars, it must be removed from the main tapir line.

"The earliest member of the subfamily Tapirinæ, or true Tapirs, is found in the Phosphorites of France, there being a considerable interval between the latter formation and the Oreodon Beds of the White River Miocene.

"5. In contrast with the other Perissodactyla of the White River formation, the premolars of *Protapirus* have not assumed the complexity of the true molars.

"6. The foot structure of Protapirus is nearly as far advanced in its evolution as that of the existing American tapir." (Bull. Am. Mus. Nat. Hist., Aug., 1893.)

Geological News,—ARCHEAN—According to Prof. G. H. Williams, volcanic rocks are widely distributed through the crystalline belt of eastern North America. The writer limits the term *volcanic* to effusive or surface igneous rocks, in contrast to such as have solidified beneath the surface. The areas of these ancient volcanic rocks now known fall roughly in two parallel belts; the eastern embraces exposures in Newfoundland, Cape Breton, Nova Scotia, Bay of Fundy, Coast of Maine, Boston Basin and the central Carolinas; the western belt crosses the Eastern Townships and follows the Blue Ridge through Southern Penn-

sylvania, Maryland, Virginia, North Carolina to Georgia. (Journ. Geol., Vol. II, 1894.)

PALEOZOIC—A remarkably well preserved Lepidodendron from E'snost near Autun is described by M. B. Renault under the name *Lepidodendron esnostense.* The specimen shows the stem, leaves, fructification and roots. Attached to the rootlets are small ovoid bodies supposed by the author to be the eggs of an aquatic insect, to which he gives the name *Arthroon rochei.* These same bodies have been observed upon *L. rhodumnense,* found near Combres (Loire), and described by M. Renault some fifteen years ago. (Rev. Sci., Feb., 1894.)

Mr. J. M. Clarke reports the discovery of a perfect specimen of the extreme apex of an Orthoceras, showing the nature of the protoconch. The fossil was found in the Styliola limestone of the Genesee shales, on Canandaigua Lake, New York, in an association of species which represents the earliest appearance in North America of the fauna of *Goniatites intumescens* Beyrich. The specimen consists of the apical chamber, to which the protoconch is attached. The upper end of the specimen shows the first septum to be circular and with a central sipho. The lateral walls of the first chamber taper rapidly to the plane of conjunction with the protoconch, and its depth is about one half that of the latter. The protoconch itself is semi-ovoid in shape, and when pared with those of Orthoceras previously described or figured [in the shrunken condition] is of very large size. It shows no indication of shrinking and its distal extremity is perfectly smooth. The length of the entire specimen is .85 mm.; that of the protoconch, .60 mm.; and the diameter of the first septum 1 mm. (Am. Geol., Vol. XII, 1893.)

MESOZOIC.—From a study of the fossil mammalia of the Stonesfield slate, Mr. E. S. Goodrich concludes that the primitive mammalian molar was probable tritubercular, and that the triconodont type was derived from it by degeneracy, contrary to the views of Cope and Osborn who assume that the primitive mammalian molar was represented by a simple reptilian cone which subsequently acquired a cusp in front and behind giving the Triconodont type, from which the Tritubercular type was derived. (Quart. Journ. Micros. Sci., Vol. 35.)

Mr. R. Lydekker figures and describes a new carnivorous Dinosaur from the Oxford Clay of Peterborough. The specimen comprises the anterior and posterior extremities of the left ramus of the mandible, and represents one of the Thecodontosauridæ. Since it differs from the described genera by the marked deflection of the mandibular symphy-

sis, it is referred to a new genus, Sarcolestes, with the specific name leedsii. (Quart. Journ. Geol. Soc., 1893.)

Cenozoic.—The British Museum has lately received an extinct skate from the Lower Tertiary Limestome near Cairo, Egypt. It is described by Mr. A. S. Woodward under the name *Mylobatis pentonii.* The specimen consists of the jaws, showing the dentition, which, according to the writer is the largest specimen of Mylisbotis dentition that has hitherto reached any museum. The maximum width of the disk of this extinct species is estimated at not less than five meters. (Proceeds. Zool. Soc. London, 1893.)

MINERALOGY AND PETROGRAPHY.[1]

The Eruptive Rocks of Cape Bonita, Cal.—The eruptive rocks forming the main mass of Cape Bonita, the northern Cape separating San Francisco from the Pacific Ocean, are spherical basalts and diabases, in addition to basic tuffs. The basalt is remarkable for the great spheroidal masses that characterise it. In many places the entire rock-mass is a closely packed aggregate of large bolster-like bodies, whose cross-section is approximately circular. These consist of a compact amygdaloidal rock, made up of lath-shaped plagioclases lying in a glassy base. In all cases the rock of the spheroids is much altered, and is of the same composition in the interiors as on the peripheries of the bodies. In a few cases augite may be detected as small grains that are younger than the plagioclases, but the rock on the whole is very uniform in character. The diabase is more interesting petrographically. It is younger than the basalt and has intruded this rock. Besides the usual constituents of diabase it contains iddingsite in large, rounded, idiomorphic forms. The augite varies in color from nearly colorless to a deep violet red, the latter varieties possessing a pleochroism in yellowish green and violet red tints. A qualitative test showed the presence of titanium. Sometimes the augites of different colors are intergrown, when they are optically continuous, and not infrequently the mineral is intergrown with brown hornblende. The outlines of the iddingsite are strongly suggestive of olivine. It was one of the earliest separations from the magma, being included in the augite and in the hornblende. Its own enclosures are magnetite and chromite or picotite. In some phases of the rock both green and brown hornblende are present. Both of these are regarded as original and as of the same age as the augite, for they are frequently intergrown with the pyroxene as well as with each other. In one place the diabase is variolitic, with variolites composed of tiny brushes and crystallites of various minerals, lying in a microlitic diabasic groundmass. Iddingsite occurs both in the groundmass and in the varioles. The pyroclastic rock associated with the basalt and the diabase is probably an ash of a basaltic character. Some of its component fragments resemble closely the material of the spheroidal rock. Analyses of the rocks discussed are given by Mr. Ransome,[2] in a recent number of the University of California Bulletin.

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Bull. Geol. Dept. Univ. Cal., Vol. 1, p. 71.

Lamprophyres near the Shap Granite Mass.—Near the Shap granite in the North of England there are numerous dykes of minette and kersantite that are believed by Harker[3] to be the dyke facies of the granite, just as fourchite and ouachitite are regarded by Rosenbusch as dyke facies of eleolite-syenite. These lamprophyres contain many rounded blebs of quartz and corroded crystals of orthoclase, both of which appear to owe their present shapes to resorption processes, since both minerals are surrounded by resorption borders. The dyke rocks are thought to be genetically connected with the granite because of their age and distribution, and because of the fact that they contain the quartz and orthoclase above referred to, and also sphene, which is a characteristic component of the granite. A study of the literature of the lamprophyres shows that these rocks are often associated with granites, and hence Harker believes that the group may be discovered to be genetically related to this group of plutonic rocks. A special feature of the lamprophyres pointed out by the author is that while the total alkalies in them is about equal in amount to the sum of the alkalies in the associated granite, the potash in the former always bears a larger ratio to the soda than it does in the latter rock. It is suggested that the granite and the lamprophyres are portions of the same magma that became differentiated by gravity. From the supernatant layer, which was acid, quartz and orthoclase separated and then settled down into the lower basic portions of the mass. These were then partially dissolved, the solution of the orthoclase accounting for the large proportion of potash in the lamprophyres. In a later paper the author[4] argues against the view of Diller and Iddings that the sporadic quartzes in certain basalts and other basic rocks are the result of crystallization under other than the normal conditions. He thinks that in all these cases the quartz may have originated as outlined above.

The Geology of Conanicut Island, R. I.—The carboniferous phyllites of Conanicut Island in Narragansett Bay are cut by a mass of coarse-grained muscovite granite porphyry that has produced contact effects in the surrounding sedmentaries.[5] The granite, which exhibits many evidences of its intrusive nature, was regarded by Dale[6] as a metamorposed clastic rock, forming the lowest member of the bedded series at this place. The phyllites near the contact with the granites

[3] Geol. Magazine, 1892, IX, p. 199.
[4] Ib. IX, p. 485.
[5] L. V. Pirsson. Amer. Jour. Sci., 1893, XLVI, p. 363.
[6] Proc. Bos. Soc. Nat. Hist., 1883, XXII, p. 179.

have been changed into hornstones and knotty schists. Besides the granites the only other intrusives cutting the slates are two dykes of minette, both of which show the effects of pressure. One of the dykes consists essentially of orthoclase and two generations of biotite. It contains also apatite and zircon and large quantities of plagioclase and calcite. In the squeezed phase of the rock the biotite has been changed to chlorite. The material of the second dyke differs from that of the first one, only in that it has been more thoroughly squeezed and consequently has suffered greater alteration.

Petrographical News.—Sears[7] finds that the porphyritic feldspar in the rock from Marblehead Neck, Mass., called by Wadsworth[8] trachyte, are anorthoclases, and that much of the feldspar of its groundmass is of the same nature, consequently the rock is a keratophyre. Analyses of the rock and of one of its phenocrysts follow :

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	H_2O
Rock	70.23	.03(?)	15.00	1.99	·	.24	.33	.38	4.99	4.98	.06	2.19
Felds.	65.66		20.05	tr.	tr.	.13	.67	.18	6.98	6.56		.41

The report of the State Geological Board of Michigan[9] contains brief microscopic descriptions of certain eruptive, sedimentary and schistose rocks of the Upper Peninsula by Drs. Patton and Lane. Among the former are described granites, syenites, serpentine and lamprophyres. Among the sedimentaries graywackes, quartzites and slates, and, among the foliated rocks, amphibolites and hornblende schists. The amphibolites are principally altered diabases. Quartz diabases are mentioned by Lane as existing in dykes cutting graywackes and slates that are sometimes changed on the contact into spilosites, and quartzites that are altered near the intrusive into Lydian stone. Dr. Wadsworth, in the same volume, gives an outline scheme of his classification of rocks (eruptive and sedimentary), the principles of which were first ennunciated at length in his Lithological Studies.[10]

Graeff[11] has found, in an old hand specimen of tephrite from Horberig in the Kaiserstuhl, a holocrystalline basic concretion with a structure approaching that of theralite.

[7] Bull. Mus. Comp. Zool., Vol. XVI, p. 167.
[8] Proc. Bost. Soc. Nat. Hist., XXI, p. 288.
[9] Rep. State Board of Geol. Survey for 1891-92. Lansing, 1893.
[10] Mem. Mus. Comp. Zool., 1884, XI.
[11] Versamm. Oberrh. Geol. Ver. Ber., XXVI, 1893.

A modification of the microchemical method for determining iron in minerals is given by Lemberg.[12] It consists in producing Turnbull's blue from the ferrous sulphide precipitated on the mineral in question.

Alurgite and Violan from St. Marcel.—Among the minerals from the Manganese mines of St. Marcel, Piedmont, *alurgite* and *violan* haʌe always excited considerable interest because of their rich color and their variety. The alurgite was described by Breithaupt as a deep red mica. Penfield[13] has recently obtained a sufficient quantity of the material for study. He describes it as monoclinic in crystallization and micaceous in habit. Its cleavage plates are flexible and somewhat elastic. It is biaxial with $2\ E_{na} = 56° 32'$ (average) and its dispersion is $\rho > v$, but often plates show a uniaxial optical figure, due, as the author supposes, to twinning. The mica is one of the first order, and in spite of its dark color, its pleochroism is very slight. Density = 2.835—2.849. H = 3. Composition:

SiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	MnO	MgO	K_2O	Na_2O	H_2O	Total
53.22	21.19	1.22	.87	.18	6.02	11.20	.34	5.75	= 99.99

In the formula $H\ R_2\ (Al\ OH)\ Al\ Si_4O_{12}$, R = K and Mg OH. Alurgite is thus a distinct species, which is more nearly allied to lepidolite than to muscovite, although it is a potash mica. The alurgite is associated with a jadeite composed largely of a soda-rich pyroxene that is pleochroic in pale rose and pale blue tints. Its density is 3.257—3.382, and composition (mean of two analyses):

SiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	MnO	MgO	Ca_2O	Na_2O	K_2O	Ign	Total
54.59	9.74	11.99	1.06	.58	5.03	7.24	9.32	.24	.37	=100.16

corresponding to $Na\ R(SiO_3)_2$ in which R = Al, Fe''', Mn'''. The mineral occupies about the same position in the pyroxene group as glaucophane does among the amphiboles. In composition it agrees most closely with the chloromelanite from Mexico analysed by Damour.[14]

For purposes of comparison with this pyroxene, the author analysed a specimen of violan whose density was 3.272 — 3.237, with this result.

SiO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	MnO	MgO	CaO	Mn_2O	K_2O	Ign	Total
53.94	1.00	.86	.88	.36	16.63	23.80	1.22	.05	.66	= 99.44

The figures indicate a mixture of the diopside, jadeite and acmite mole-

[12] Zeits d. deuts. geol. Ges., 1892, p. 823.
[13] S. L. Penfield. Amer. Jour. Sci. XLVI, p. 288.
[14] Bull. Soc. Min. d. Franc, IV, 1881, p. 157. Cf. also foot-note No. 30.

cules in the proportions 90.8 : 4.1 : 2.4, with the addition of 2.7% of the molecule Na Mn $(SiO_3)_2$. The mineral is essentially a blue variety of diopside, differing from the anthochroite of Igelström[15] and from the blue pyroxene of Merrill and Packard.[16]

Zonal Plagioclase.—Herz[17] has shown by a study of the position of axial planes in successive zones of zonal plagioclase, and by the values of the respective cleavage angles, that the zonal banding in this mineral is due to the concentric growth of envelopes of different composition. The axial planes and the cleavage angles always correspond with the extinction angles in the corresponding band. It had been suggested by Grosser that the regular decrease in the extinction of the shells of a zonal plagioclase is due to difference in the orientation of the successive envelopes and not to a difference in their chemical composition. Herz's work proves conclusively that the decrease in the value of the extinction is not due to differences in orientation of the same chemical substance.

Hercynite in Gabbro.—Small octahedra and large irregular masses of the green spinel hercynite occur in an altered gabbro at Le-Prese, in the Valtellina, Switzerland. According to Linck,[18] it is found as irregular granular masses within the rock, and as small octahedral crystals enclosed in its plagioclase and associated with corundum sillimanite and biotite. The spinel includes small quantities of biotite, small plates of ilmenite, resembling the plates in hypersthene, a little pyrite, etc. An analysis of tolerably pure material yielded :

SiO_2	Al_2O_3	Fe_2O_3	MgO	FeO		Total
1.59	59.62	3.10	9.38	25.30	=	98.99

which corresponds to (Fe Mg) Al_2O_4 in which Fe : Mg = 3 : 2.

Optical Constants of Topaz.—Four Japanese topaz crystals and one crystal of the same mineral from New South Wales are described by Hahn,[19] and some of the optical constants of the former have been determined. One of the crystals from Otamjama near

[15] AMERICAN NATURALIST, 1890, p. 74.
[16] Ib., 1892. p. 848.
[17] Min. u. Petrog. Mitth. XIII, p. 341.
[18] Sitzb. d. Kön-preuss. Akad. d. Wiss. zu Berlin. Phys.-Math.-Classe., 1893, p. 47.
[19] Zeits. f. Kryst., XXI, p. 334.

Kioto, has the following refractive indices and optical angles for yellow light: $\beta = 1.6182$, $\gamma = 1.6252$, $2\,V = 62° 40'$, $2\,E = 114° 31'$. The crystal from New South Wales has $2\,E = 113° 18'$.

Mineralogical News.—Stöver announces the discovery of fine *celestites* in the Jurassic schists of Brousseval in France. Their axial ratio is .7803 : 1 : 1.2826, and index of refraction for sodium light = 1.6235. The crystals are one centimeter in length, and are elongated parallel to $\breve{a}$. Similarly habited crystals occur also in the marl of Ville-sur-Sault. The axial ratio of these is .7806 : 1 : 1.2797, and density = 3.991.

Rheineck[20] has made another attempt to calculate from the published analyses general formulas for *tourmaline* that will not only represent the composition of all varieties of the mineral, but which will also express its relationship with micas. He concludes that there are two alkaline varieties, viz.: $Al_4\,Si_3\,B\,H_3O_{15}$ and $Al_4\,Si_3\,B_2\,H_4\,O_{17}$, and two magnesium varieties, $Al_4\,Si_5\,B_2\,Mg_4O_{25}$ and $Al_4\,Si_5\,B_2\,Mg_3\,O_{22}$, by whose intermingling all other varieties are formed.

Several crystallographic observations of Baumhauer[21] are of interest. A yellow *diopside* from the Canton of Graubünden (Grisons), Switzerland, has an axial ratio $a : b : c = 1.0918 : 1 : .5879$, with $\beta = 74° 12' 15''$. *Binnite* crystals from Infeld in the Binnenthal are certainly tetartohedrally hemihedral, as the author has succeeded in finding upon them, well-developed, the planes $\frac{0}{2}$ and $\frac{202}{2}$.

Oebbecke[22] mentions the occurrence of *topaz* with feldspar, apatite, tourmaline, fluorite, etc, at Epprechtstein and its existence in the granite of the Gregnitzgrund in the Fichtelgebirge.

The *arsenopyrite* of Weiler in Alsace occurs in an arkose from which Scherer[23] has obtained crystals sufficiently large for measurement and analysis. These crystals are prismatic in habit, and have an axial ratio $a : b : c = .6734 : 1 : 1.1847$. A mean of two analyses gave figures corresponding to Fe : S : As = 1 : .9933 : .9751.

Mallard[24] has come into the possession of some beautiful little crystals of *periclase* that were found implanted on a white compact crust produced in the culcination of some of the Stassfurt materials.

Several twins of *aragonite* from the tunnel of Neussargues in Cantal,

[20] Zeits. f. Kryst., XXII, p. 52.
[21] Ib., XXI, p. 200.
[22] Ib., XXII, p. 273.
[23] Ib., XXII, p. 62.
[24] Bull. Soc. Franc. Min., XVI, p. 18.

France, are reported by Gonnard[25], and some fine crystals of *pinite*[26] from Issertaux, near St. Pardoux in the Auvergne.

Miscellaneous.—In his development of the theory of the constitution of the *micas*, Clarke[27] has reached the problem of the lithium members of the group. This he solves by supposing lepidolite to be an admixture of the simple molecules $Al\ F_2\ Si_3\ O_8\ R_3'$, in which R′ is principally lithium, and $Al_3\ (SiO_4)_3\ R_3'$, in which R_3' may be either K_2H or KH_2.

Retgers[28] suggests molten phosphorus and a solution of phosphorus in CS_2 as media for use in determining the indices of refraction in highly refracting substances. A tiny fragment of the phosphorus may be melted between two object-glasses, when it spreads as a thin sheet between them, and, upon cooling, remains transparent. Its refractive index is 2.144. That of a saturated solution of the substance in CS_2 is 1.95.

Some time ago, Damour[29] suggested the name *chloromelanite* for one of the varieties of jade found in ancient implements. He discovers now that the material contains garnets and pyroxene. It thus resembles the rock eclogite. The pyroxene from a Mexican specimen is composed as follows:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	Total	Sp. Gr.
56.57	17.21	8.86	4.44	2.12	10.70 =	99.90	3.37

Nordenskjöld[30] has begun the study of snow crystals. The first contribution to his discussion is a series of handsome photographs of a large variety of flakes, including prismatic, stellar and other forms some of which contained liquid enclosures at the time of their fall.

[25] Ib., XVI, p. 10.
[26] Ib., XVI, p. 16.
[27] Bull. Am. Chem. Soc., XV, May, 1893.
[28] Neues Jahrb. f. Min., etc., 1893, II, p. 130.
[29] Bull. Soc. Franc. Min., XVI, p. 57. Cf. also foot-note No. 14.
[30] Ib., XVI, p. 59.

BOTANY.[1]

What is Mycoderma ?—1. In my papers on the yeasts, I have mentioned the doubtful position of the sprouting fungus *Mycoderma* which morphologically and systematically stands near to the *Saccharomycetaceae.* From the latter, it is easily distinguished on account of its high refractive power, the cells being also rectangular, not spore-bearing, and very apt to aggregate in masses, or in a film. When beer, wine, or other sugar-containing liquids are exposed to the air, the *Mycoderma* will very soon form a gray, greasy looking, uneven film on the surface of the liquid. Hitherto, it was supposed that this fungus could not form alcohol; Lasché has, however, found four species which yield ¼ to 2½ vol % of alcohol (See Der Braumeister, Chicago, 1891, No. 7); Winogradsky found that the morphology of the cells changes according to the amount of organic material given in a constant solution of inorganic nutritive matter. (See Centralbl. f. Bakteriol. u. Paras., 1884, p. 164). Lately, F. Lafar showed that at least one species will produce acetic acid. (Ibid, XIII, p. 684–697 1893, w. pl.).

In 1879 Hansen expressed his opinion that there were undoubtedly more than the two species—*M. cerevisiae* and *M. vini*—described by Pasteur (Studies on fermentation, pp. 77, 110, pl. IV) in existence. These two named species cannot be distinguished from each other, and they must be regarded as synonyms to all the species—at present known. The macroscopic appearance of these fungi was mentioned in the January No. of the *American Monthly Microscopical Journal.*

2. The name *Mycoderma* was given by Pasteur to the bacterium of acetic fermentation. As far back as 1834, Kützing determined the vegetable nature of this ferment; he named it *Ulvina aceti.* Pasteur (See Etudes sur la vinaigre) and Turpin took the question up again, and studied the morphology of the organism. In 1879, Hansen found a new species which assumes a blue color with iodine or IKa., while the other species became yellow when thus treated. He found, lately, still another species which is also colored blue with iodine, namely, the species *kützingianum.* The genus-name was, on the suggestion of Zopf, changed into *Bacterium.* (See Berichte der Deutschen Botanischen Gesellschaft, 1893, p. (69–73). Three species of acetic fermentation

[1]Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska,

bacteria are thus known at present, namely, (1) *Bacterium aceti* (Kütz.) Zopf, (2) *B. pasteurianum* Hansen, and (3) *B. kützingianum* Hansen. The cardinal temperatures are: Minimum for (1), 4°–5° C; for (2), 5°–6° C. Maximum is for all of them 42°–43° C, and optimum 34° C.

Morphologically, these species consist of (1) long cells, (2) swollen cells, and (3) chains of short bacula. By 40° C–40°, 5 C pure cultures were in good development, during which some of the cells of the chains grew very long, and in twenty-four hours, there was a typical vegetation of long cells, totally different from the original culture. If this new culture is exposed to a temperature of 34° C, the original chains are again formed. The long cells measured 200μ and more; by 34° C; they first swell in one or more places, sometimes assuming ball shape (diam. 11μ), then they are divided into typical chains. Nägeli regarded the long and the swollen cells as abnormal forms.

When we speak of the influence of outward agencies upon the life-activity of organisms like those mentioned above, we have generally described the influence in its action only upon *one feature* of such activity. It is not at all sure that the cardinal temperatures of *fermentation* are identical with those of the *life* of the yeast, or with those of the *cell-division* or *spore formation* of the latter. We know that the cardinal temperatures of germination, transpiration, respiration, assimilation, geotropism, heliotropism, hydrotropism, rheotropism, etc., etc., in "higher" plants are not always identical. In the instance mentioned above, we see that the *cell-division* has its cardinal temperatures, a conclusion which we may draw from the observations. We further see that bacteria are more polymorphus than is suspected, and that a new road is open for investigation which doubtless will tend to broaden our knowledge of microörganisms and of many important physiological questions.

J. Christian Bay.

The so-called "Russian Thistle."—It is the fate of few weeds to reach so suddenly such great notoriety as that recently attained by *Salsola kali* L. var. *tragus* DC., the so-called "Russian Thistle." If one turns to any of the botanical manuals he finds no plant under this common name. He will find the "Common Salt-wort." of the "sandy shore, New England to Georgia" described in such mild terms as to give no idea of the weed as it appears to the farmer upon the western plains.

The species is a native of mountainous regions in both hemispheres.

In Europe it occurs from Spain to France, Belgium, Holland, Great Britain, Ireland, Denmark, Norway and Sweden, and along the Mediterranean coast of France, Italy, Greece and Turkey. Even the sandy tracts of interior countries are not free from it; thus it is found in Germany, Austria, Hungary and Russia. It occurs also in temperate Asia. In America as stated above, it extends from New England to Georgia. The variety is apparently much less widely distributed, but the exact limits of its geographical range are not well defined, most recent authors not regarding it as sufficiently distinct to warrant separate treatment.

The technical description of the variety (to which alone the name Russian Thistle is applied) as drawn up by L. H. Dewey of the United States Department of Agriculture, is as follows:

"*Salsola kali* L. var. *tragus* DC. Prod. XIII, 2, 187 (1849). Herbaceous, annual, diffusely branching from the base, usually densely bushy at maturity, .5 to 1 m. high and twice as broad, smooth or slightly hispid; root simple, dull white, slightly twisted near the apex; leaves alternate, sessile; of the young plant deciduous, succulent, linear or subterete, 3 to 6 cm. long, spiny-pointed, and with narrow, denticulate, membranaceous margins near the base; leaves of mature plant peristent, each subtending two leaf-like bracts and a flower, at intervals of 2 to 10 mm., rigid, narrowly ovate, often denticulate near the base, spiny-pointed, usually striped with red like the branches, 6 to 10 mm. long; bracts divergent, like the leaves in size and in all respects but position; flowers solitary and sessile, perfect, apetalous, about 10 mm. in diameter; calyx membranaceous, persistent, enclosing the depressed fruit, usually rose colored, gamosepalous, cleft nearly to the base into five unequal divisions about 4 mm. long, the upper one broadest, the two next the subtending leaf next in size and the lateral ones narrow, each with a beak-like, connivent apex, and bearing midway on the back a membranaceous, striate, erose-margined wing about 3 mm. long, the upper and two lower ones much broader than the lateral ones; stamens 5, about equalling the calyx lobes; pistil simple; styles 2, slender, about 1 mm. long; seed 1, obconical, depressed, about 2 mm. in diameter, dull gray or green, exalbuminous, the thin seed-coat closely covering the spirally-coiled embryo; embryo about 12 mm. long with 2 terete cotyledons."[2]

Salsola is one of the prominent genera of the family *Chenopodiaceæ*, and is the most important member of the tribe *Salsoleæ*. Its forty spe-

[2]Bulletin 31, Agricultural Experiment Station of the University of Nebraska, Dec. 1893.

cies are very widely distributed in Europe, Asia, North and South Africa, America and Australia.

The Russian Thistle appears to have come to this country in flaxseed imported directly from Europe to South Dakota seventeen or eighteen years ago. For a while it was popularly supposed that the Russian settlers in South Dakota had purposely brought it for use as a forage plant, but this is now generally discredited. The name "Russian Thistle" is, however, so well fixed that it will continue to be used in spite of its inappropriateness, just as we say "Canada Thistle" for another Old World weed.

For a number years after its introduction it attracted little attention, and it was not until seven or eight years ago (1886) that it began to be troublesome in South Dakota. Since this time it has spread with much rapidity. Both of the Dakotas are now badly overrun with it. A few years ago it invaded Nebraska, coming into the State about Valentine, and in Knox, Cedar and Dixon Counties. It probably came to the first named place with the United States soldiers stationed at Ft. Niobrara, a few miles east of the town of Valentine. The frequent transfers of troops from forts in South Dakota afford ready means of transportation to weeds of this nature. For several years it has been spreading from this point. The counties mentioned are separated from South Dakota by the Missouri River, but here and there are ferries over which teams frequently pass, and at these points the Russian Thistles are very abundant.

The railroads have aided materially in their distribution, as is shown by the fact that by the end of 1893, Russian Thistles were to be found in nearly all parts of Nebraska, and in nearly all cases they were at first confined to a narrow belt along the track. Year by year they spread from this belt, moving most rapidly along the lines of greatest travel. The wind, also, is an efficient agent in spreading them, since in many cases, the nearly spherical plants are broken off at the root, and rolled for long distances as "tumbleweeds," scattering their seeds throughout their course.

In Minnesota, Iowa and Wisconsin, Russian Thistles have appeared, and here again they have been brought in by the railroads. The reason why the railroads have had so much to do with the distribution of this weed, is that finding by the side of the tracks much unsodded ground, they spring up here in great numbers, and in the fall when they break off by the winds they are caught up the passing trains and carried away on the trucks or steps of the cars or on the pilot or in the machinery of the engine.

The states of the Plains, the Dakotas and Nebraska, and those next adjacent, have taken steps to warn their people of this invading weed by bulletins and through the public press. The United States Department of Agriculture sent an agent to inspect the invaded region, and issued a special bulletin on the subject. The Russian Thistle is a common topic for papers and discussions before Agricultural and Horticultural Societies, farmer's institutes, farmer's clubs, alliance meetings, etc. It will soon be so well known upon the Plains that it will no longer be allowed to grow unmolested because unrecognized.

CHARLES E. BESSEY.

ZOOLOGY.

Reproduction of the Foraminifera.—Fritz Schaudinn has studied this little known subject and presents[1] these results: The reproduction is effected by the division of the protoplasm into, in different individuals, a varying number of pieces which secrete shells and grow into the adult after different methods according to the species. The following modifications of the process are noted:

I. The division of the protoplasm, the assumption of form, and the secretion of the shell by the pieces is completed within the shell of the mother. The embryos then leave the mother either, through the mouth, or, when that is too small, by a breaking through the shell. II. The division occurs inside the mother shell and the embryos escape as naked plasmodia, to develop the shell outside. III. The protoplasm leaves the mother shell as a connected mass and all processes occur outside the old shell. In all cases the mother, before reproduction, is polynucleate, the embryos are usually uninucleate but in some cases 2 or 3 and rarely more nuclei are present.

Schaudinn further calls attention to a peculiar type of nuclear multiplication which he finds common in this group but which has hitherto escaped notice. He has never seen division into two daughter nuclei, but in all forms studied, after a series of changes the mother nucleus divides into many daughter nuclei. Briefly summarized these changes are as follows: Through the absorption of fluid the homogeneous mother nucleus becomes vesicular and then inside this, by means of an achromatic filament apparatus, an equal division of the whole nuclear substance (chromatin and achromatin) into numerous portions follows, and these by disappearance of the nuclear membrane pass freely into the cytoplasm and become independent nuclei.

Regeneration in Hydroids.—Dr. C. B. Davenport attacks[2] one aspect of the problem of regeneration. One of the fundamental assumptions of theories of heredity is that regeneration, like development from the egg depends upon the pre-existence of embryonic tissue but a disputed point is whether embryonic tissue is qualitatively different in different parts of the body, *i. e.*, whether it can produce only certain definite and distinct things or whether it is potentially the same

[1]Biol. Cblt. XIV, 163, 1894.
[2]Anat. Anzeiger IX, 283, 1884.

and the different results depend on agencies outside the developing cells. This he applies to the regeneration of lost parts in Obelia, by by cutting off the hydranths and their stalks at different levels. His conclusions are:

"First. The regenerative tissue is not differentiated at different levels to produce different things independent of environment; but on the contrary, the embryonic tissue at all levels may produce the same things.

"Second. Wholly aside from the production of definite things, there may be acquired in certain embryonic tissues a usual method of development, independent of environment. * *

"Third. The curves of regeneration bring out a second wholly unexpected series of facts; namely, the tendency of regenerative tissue at all levels to produce preferably certain forms. * * * "

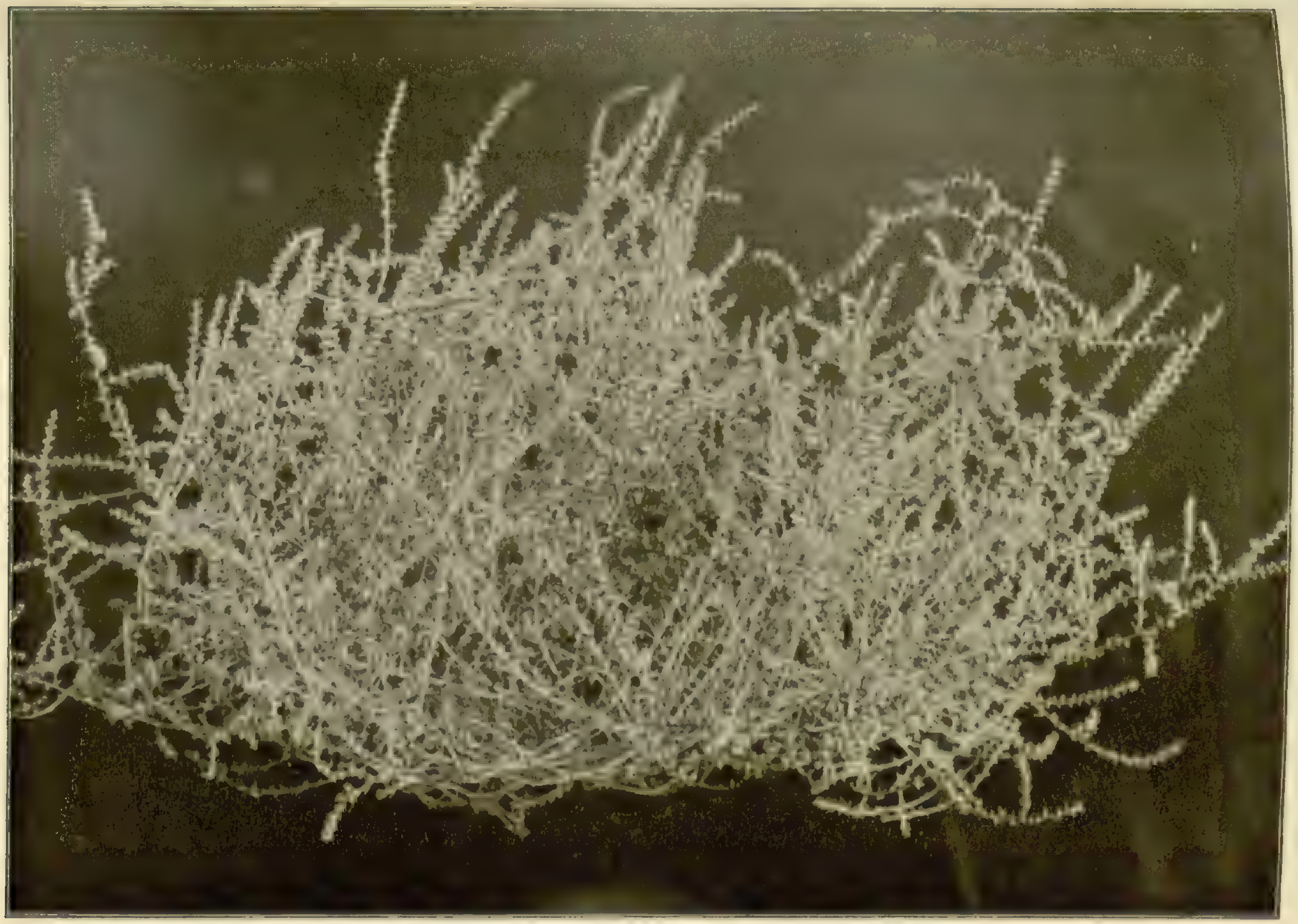
Closely allied to these observations of Davenport are some by Albert Lang[3] who, working under the direction of Professor Weismann, claims that in certain hydroids, notably in Hydra, Eudendrium and Plumularia, both germ layers do not participate in the formation of the buds but that these structures proceed from the ectoderm alone which by a sort of multipolar gastrulation forms the entoderm of the bud, and is to be regarded as the sole foundation of the daughter individual. Accompanying this paper is a note by Prof. Weismann stating that the facts observed by Lang were just such as he had predicted upon theoretical grounds.

Shortly after the publication of Lang's results, his experiments were gone over by an American student who found that while he could easily duplicate Lang's figures, the conclusions based upon them were due to errors of misinterpretation and that in reality both layers do participate in the bud formation. These results have not been published. This is, however, the less to be regretted since Dr. F. Braem of Breslau has recently gone over the whole matter and he announces[4] that Lang's account is all wrong. He finds nothing which will support Lang's conclusions, there is no fusion of one germ layer with the other and never a proliferation of cells of the ectoderm of the parent to form the entoderm of the adult.

The Parietal Eyes.—Those who have kept close watch of the progress of our knowledge of the "pineal gland" can but be interested in some recent papers. Long believed to be a gland and by

[3]Zeitsch. f. wiss. Zool. LIV, 365, 1892.
[4]Biol. Cblt. XIV, 140, 1894.

PLATE X.



Russian Thistle, about one-sixth natural size, from one of the streets bordering the city park of Lincoln, Nebraska.

Descartes assigned as a proper sized organ for the residence of the soul, this structure was first pointed out by de Graaf and Spencer, almost simultaneously, as a veritable visual organ in process of disappearance. After their papers the literature of the organ grew rapidly until the veteran histologist, Leydig, announced that it was not an eye; and since he had been the first to suggest that the structure was sensory his final dictum, finely illustrated, naturally had weight. Then Beranek showed that there were two organs confused, an anterior eye and a posterior vascular or glandular structure. The two recent papers to which we have referred throw no little light upon the matter. Prof. W. A. Locy has described[5] the early phases of the eye in the Selachians and he further shows that the early optic pits are but one of three serially homologous pairs of structures which differ in their early stages only in the matter of size. The posterior pairs are traced into the optic outgrowth. In the second paper Klinckowström[6] gives a number of facts regarding the structure of the parietal organs in the South American Iguana and Tejus which in connection with the work of Locy and Beranek tempt one to indulge in speculation. With what Klinckowström has to say of the parietal eye proper we have little to do. It is rather with the secondary structures. There are in Iguana two distinct phases to the epiphysial outgrowth. In the first the parietal eye proper is cut off from its connection with the cerebral cavity thus forming the eye and the epiphysis. Next, the distal portion of the epiphysis takes on a histological character closely approaching that of the parietal eye, the deeper portion retaining its former conditions, and a constriction tends to separate this from the rest. Klinckowström naturally considers this as the temporary appearance of a second epiphysial eye. In connection with Locy's observations and especially when taken in connection with Klinckowström's further observation that there is a second nerve developed in position for this outgrowth, the conclusion is inevitable that the ancestor of the vertebrates had not three eyes but at least three pairs of eyes. As is well known the parietal nerve is not median but on one side. In some cases he found one on either side, showing that the lack of symmetry is due to a failure to develop on the part of one of the nerves. One of Klinckowström's conclusions seems a little questionable. He concludes that the parietal nerve is not strictly comparable to the optic nerve, the point apparently being that in the one case the nerve follows the optic outgrowth while the parietal nerve does not,

[5]Jour. Morphol. IX, 115, 1894. See also Anat. Anzeiger.
[6]Zool. Jahrb. Abth. Anat. VII, 249, 1894.

but enters the roof of the brain in the region of the habenular ganglion. This difference does not strike one as forcibly as a little while ago. The recent investigations of Keibel and Assheton have shown that the optic stalk is not the optic nerve, but this stalk merely forms the tract through which the true nervous elements grow inward from the retinal layer. This being the case it is easy to see that possibly in the case of the parietal nerve the outgrowth has been through other tissue.

East African Reptiles and Batrachia.—The U. S. National Museum has recently received some valuable collections of Reptiles and Batrachia from Eastern Africa and the adjacent islands and these have now been studied by Dr. L. Stejneger.[7] Among the interesting facts brought out is a better knowledge of the fauna of the Seychelles. Wallace, in his "Island Life," enumerates 11 species as found in these islands of which five are considered as peculiar to them. To-day, fifteen species of Reptiles and Batrachia are known with certainty, plus several more doubtful, as coming from these Islands and of these ten are not known from any other locality. Ten of these species are represented in the museum collections. The new species described in this paper are *Diplodactylus inexpectatus* (Seychelles), *Phelsuma abbotti* (Aldabra), *Eremias sextæniata* and *E. hoehnelii* (Tana River, E. Af.), *Mabuya chanlerii* (Tana R.), *Ablepharus gloriosus* (Gloriosa Is.), *Typhlops mandensis* (Manda Is.), *Simocephalus chanlerii* (Manda), *Causus nasalis* (West Africa), *Hypogeophis alternans* (Seychelles).

On the Iguanian genus Uma Baird.—This genus has been hitherto represented by but two specimens, and has been hence but little known. Professor Baird in his original description in 1852 did not adduce any character sufficient to distinguish it from Callisaurus Blv., and it was not until 1866 that I pointed out that the difference consists in the possession by Uma of a series of elongate free scales on each side of the digits, and on the external side of the sole, which are wanting from Callisaurus. I noted the occurrence of the genus near Tucson, Arizona, as represented by a second and adult individual; the type, a young animal, having been taken on the Mojave Desert. Since that time no additional material has come under my observation.

A renewed examination of these two specimens has shown me that they belong to two very distinct species. I accordingly name the Tuc-

[7]Proc. U. S. Nat. Mus. XVI, 711, 1893.

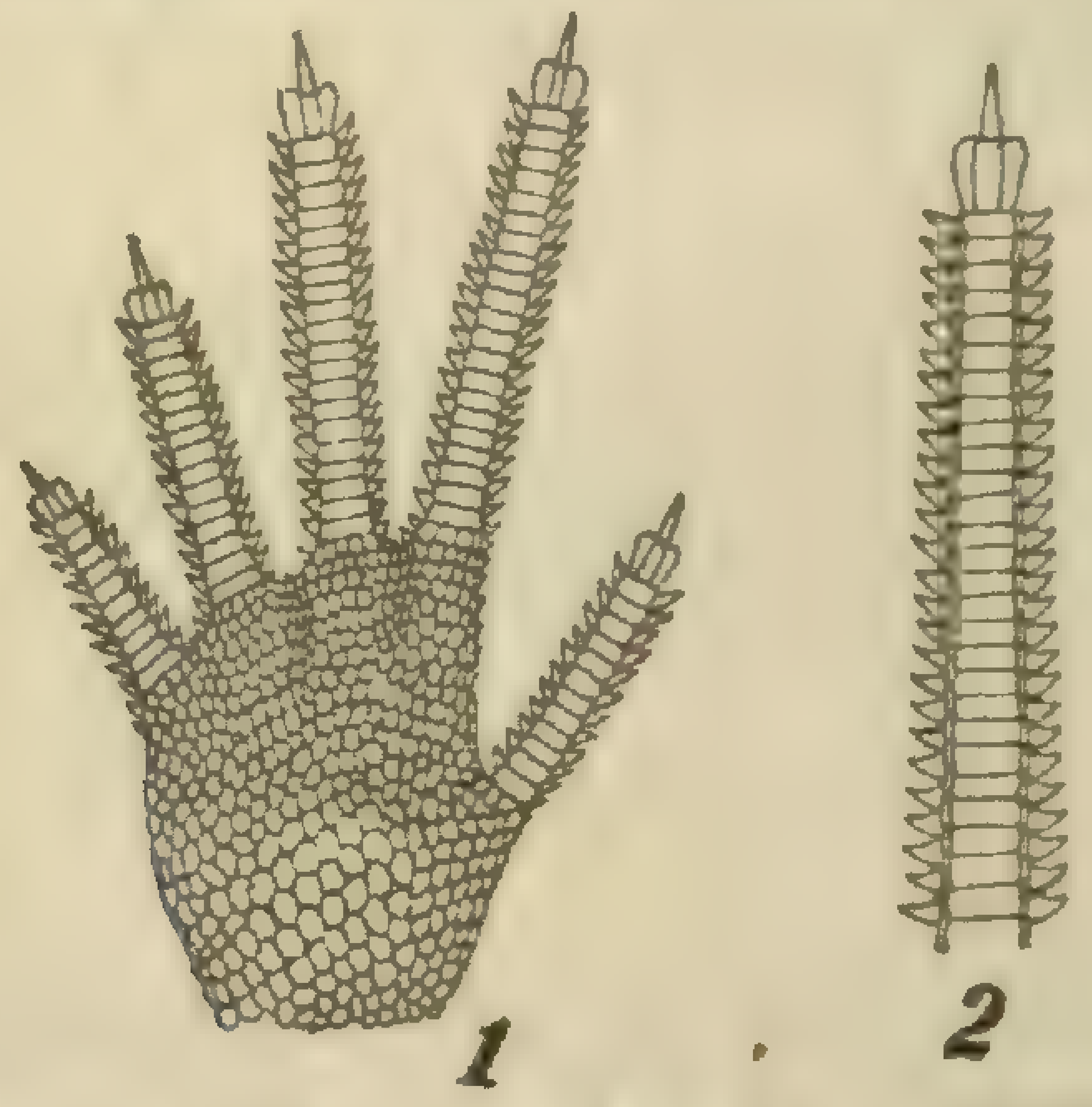
son species *U. scopifera*, and give the following differential diagnoses of the two.

UMA NOTATA Baird. Femoral pores 17–18; labial scales nearly flat; fringes of the inferior eyelid longer than those of the superior; occipital plate larger; digits longer, with shorter fringes of spines; colors pale.

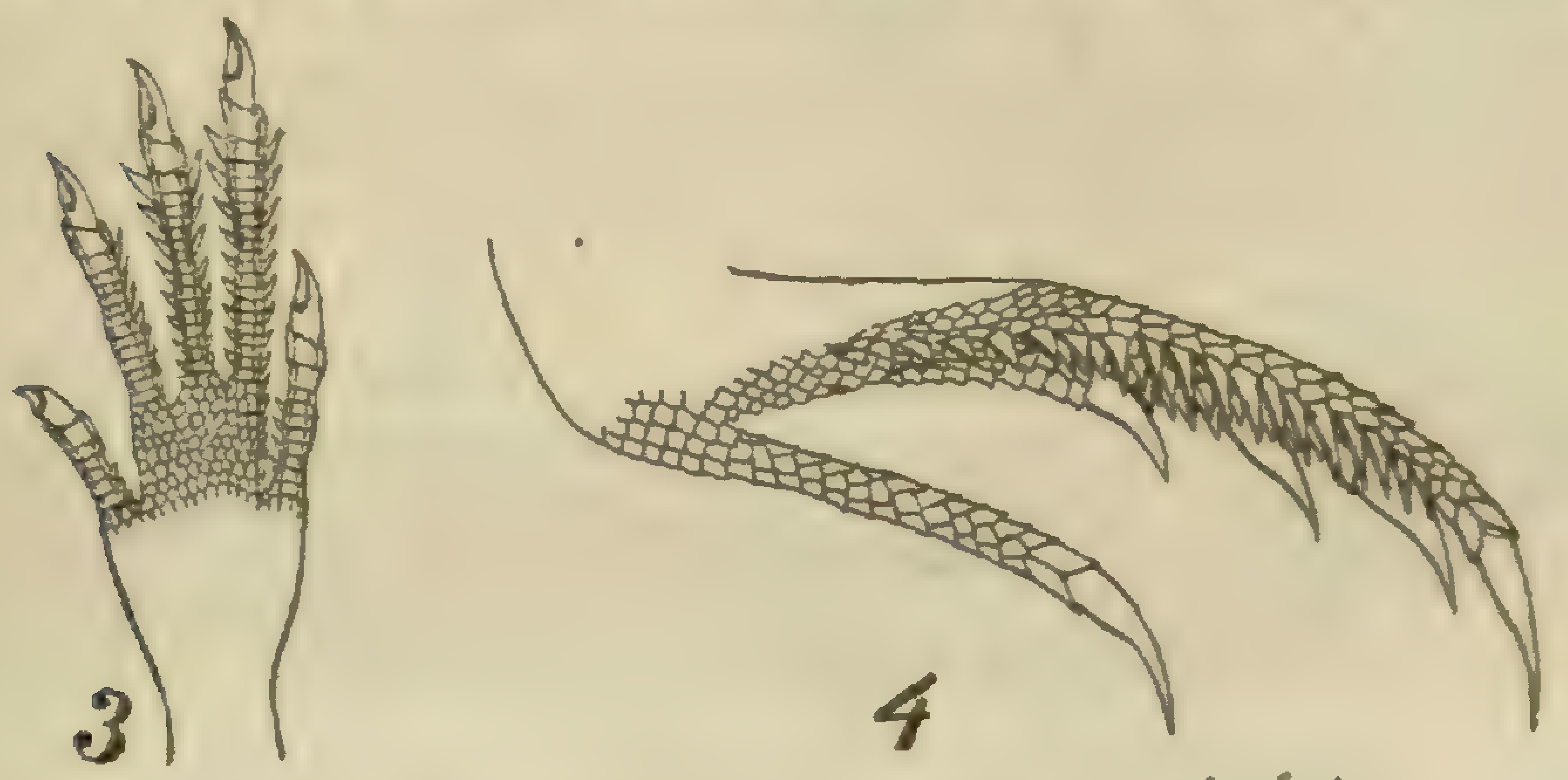
UMA SCOPARIA Cope. Femoral pores 30 in one row, with a second row of 12; labial scales strongly keeled; fringes of eyelids equal; occipital plate smaller; digits shorter, with longer fringes of spines; ground color above black, marked with closely placed discoidal light spots with a black center. (No. 6065 U. S. National Museum).

The fringed digits and sole of this genus constitute an excellent example of homoplassy. Similar fringes are present in the same positions in the Asiatic Agamid genus Phrynocephalus, and in the African Gecconid genus Ptenopus. Both of these, like Uma, are inhabitants of deserts. The spines which compose the fringes penetrate the sand, and give the animal a better hold on it than is secured by the ordinary squamation.

I give figures of the feet of *Ptenopus garrulus* Smith and *Uma scoparia* in illustration of this point.—E. D. COPE



FIGS. 1–2 *Ptenopus garrulus*; 1 anterior foot; 2 anterior digit; from Boulenger.



FIGS. 3–4 *Uma scoparia*; 3 anterior; 4 posterior feet.

On the Genera and Species of Euchirotidæ.—Professor Alfredo Dugés of Guanajuato, Mexico, has sent me an ms. description of a new Amphisbænian from the state of Guerrero, Mexico, which is allied to Bipes (Chirotes Cuv.), but which possesses but three digits, and presents various other differences from the *B. canaliculatus*,

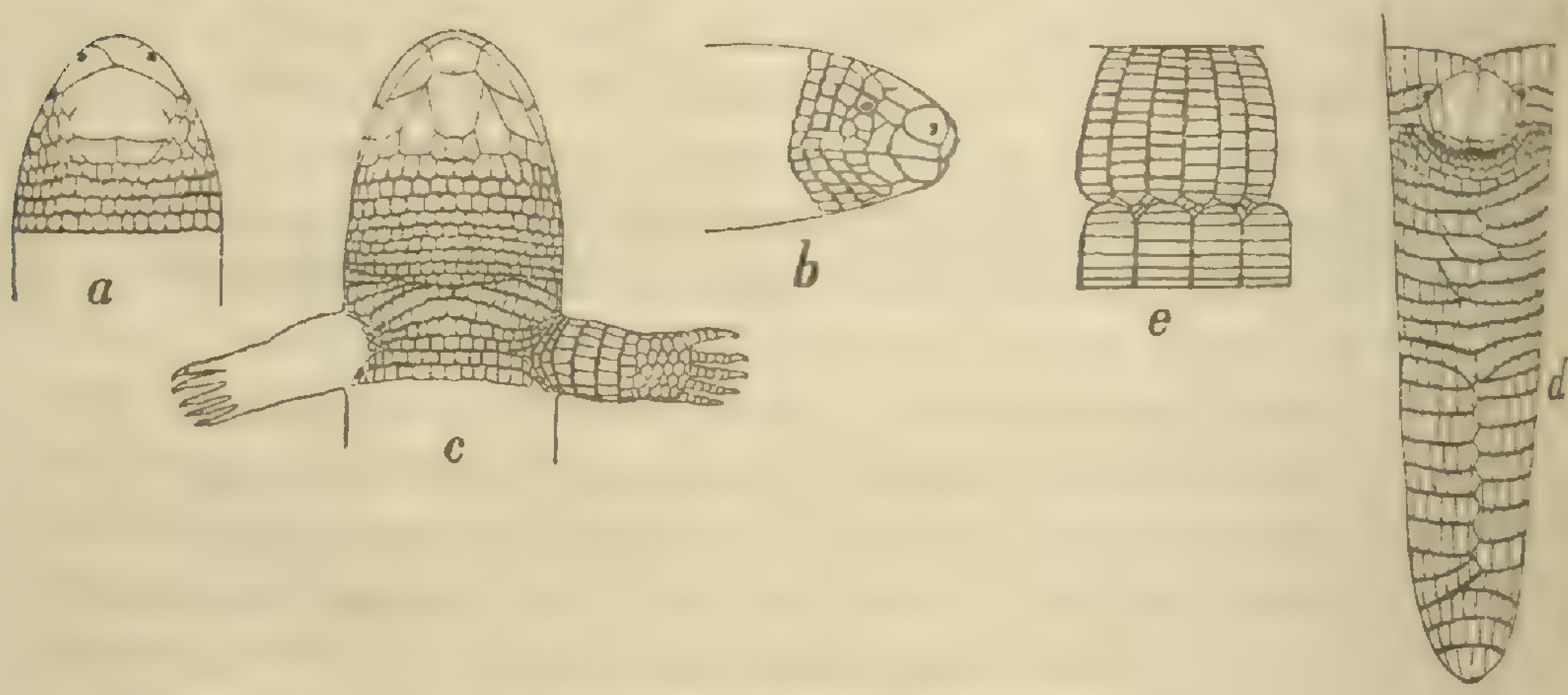


Fig. 5.—*Euchirotes biporus*, Cope.

including a much shorter tail. In endeavoring to determine its relationships with the known species of Bipes, I find that the individuals from Cape St. Lucas, Lower California, which I have hitherto assumed belong to the *Bipes canaliculatus* Lacép. really represent another species and genus. I now offer diagnostic characters of these forms, preliminary to a fuller notice in my forthcoming Scaled Reptiles of North America.

Digits five, all clawed;	*Euchirotes* Cope.
Digits five, one smaller and clawless;	*Bipes* Lacép.
Digits three, clawed;	*Hemichirotes* Dugés.

Each of these genera includes a single species, which are characterized as follows.

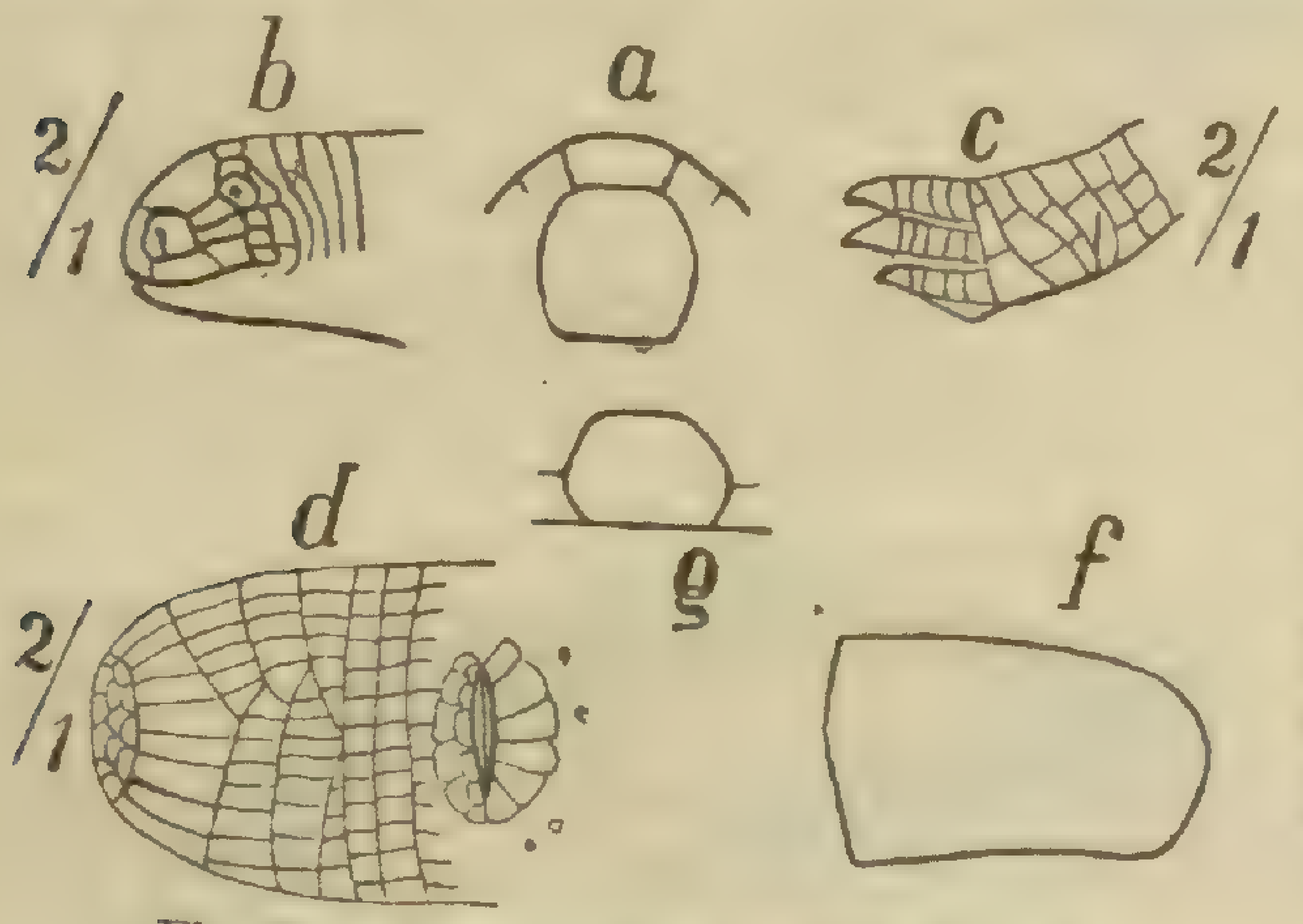


Fig. 6.—*Hemichirotes tridactylus*, Day.

Euchirotes biporus Cope, sp. nov. Tail twice as long as head; anus preceded by a transverse series of six large plates, which extend to the abdominal scuta; a single preanal pore each in a single scale in front of the external preanal plate. Nasal plates nearly in contact in front. Cape

St. Lucas, Lower California. U. S. National Museum; G. Eisen.

Bipes canaliculatus Lacép. Tail twice as long as head; preanal scuta small, preceded by a transverse row of small scales, each of which is perforated by a pore. Nasal plates well separated in front. Mexico.

Hemichirotes tridactylus Dugés. Tail but little longer than head. Anus preceded by six plates of moderate size, and these by only two pore-bearing scales on each side. Nasal plates widely separated by contact of rostral and internasal. Guerrero, Mexico; A Dugés.

Stejneger has shown that the name Chirotes Cuv. must be abandoned in favor of Bipes Lacép. of much earlier date. As the family name Chirotidae has become engrafted on our literature, I propose to retain the name Euchirotidae in place of it for the family, so as to disturb the existing custom as little as possible.

EXPLANATION OF CUTS.

Fig. 5.—*Euchirotes diporus* Cope, twice natural size.

Fig. 6.—*Hemichirotes tridactylus* Dugés, twice natural size.

Letters; *a* head from above; *b* profile; *c* from below, with fore limbs; *d* tail from below; *e* side of body; *f* profile of tail; *g* rostral plate from front.

E. D. COPE.

Zoological News.—PROTOZOA.—Blochmann again replies[8] to the oft asked question, Does the contractile vacuole empty to the exterior? in the affirmative.

F. Schaudinn has studied the *Gromia desjardinii* of Max Schultze and finds[9] that it differs from Gromia in many respects and he proposes for it the generic name of Hyalopus. He has studied its reproduction and finds that transverse fission of both animal and shell occurs, the process requiring about three weeks for completion, the mouths of the new individuals being formed in the cut ends of the shell. Similarly division into three has been noticed. Besides, he has seen in six cases the formation of swarmspores. From five to twelve hours before the formation of the spores the pseudopodia are retracted and the whole protoplasm divides into spherical portions each of which contains a large nucleus. Each of these becomes amœboid and then develops a large flagellum. After some other phases these swarmspores copulate in pairs. The history has not been followed farther.

[8]Biol. Centralblatt XIV, 82, 1894.

[9]Stzber. Ges. Naturf. Freunda Berlin, 1884, p. 13.

MOLLUSCA.—Dr. R. E. C. Stearn's recent paper, "Notes on recent collections of North American land, freshwater and marine shells received from the U. S. Department of Agriculture,"[10] adds considerably to our knowledge of the distribution of several species of Molluscs. No new forms are described.

VERTEBRATA.—H. H. Wilder points out[11] that in the adults of *Desmognathus fusca, D. ochrophœa, Plethodon erythronotus* and *Gyrinophilus porphyriticus*, lungs and trachea are completely absent, respiration taking place by the external skin.

Biétrix claims[12] that in the branchial lamellæ of sharks and teleosts the blood is contained in a system of lacunæ, which, from their lack of membrana propria and endothelium, cannot be regarded as capillaries.

Heinrich Ernst Zeigler studied the yolk nuclei of fishes some years ago. He now returns to the subject and brings[13] new evidence to support his previous thesis that after the close of segmentation the meganuclei of the yolk of sharks and teleosts contribute nothing to the development of the embryos.

Dr. T. H. Bean describes[14] a new genus and species of Blennoid Fish under the name *Plagiogrammus hopkinsii.* The type was collected with other fishes intended for the aquaria at the World's Fair at Monterey, Cal. In confinement it hides in rock crevices and seldom ventures from its place of concealment. It is about 6 inches in length.

Dr. L. Stejneger describes[15] a new species of blind-snake from the Congo region of Africa under the name *Typhlops præocularis.*

Robert Ridgway records[16] as new *Geothlypis poliocephala ralphii* coming from the Lower Rio Grande Valley, the type being found at Brownsville, Texas.

Mr. F. W. True regards Taylor's mouse (*Sitomys taylori*) as presenting such combinations of characters as to warrant its being regarded as the type of a new subgenus to which he gives[17] the name Bæomys. He also describes (l. c. p. 689) a new species of Sitomys (*S. decolorus*) from Honduras.

[10]Proc. U. S. Nat. Mus. XVI, 743, 1894.
[11]Anat. Anzeiger IX, 216.
[12]C. R. Soc. Philomath Paris, Jan., 1894.
[13]Ber. Naturf. Gesell. Freiburg, VIII, 192, 1894.
[14]Proc. U. S. Nat. Mus. XVI, p. 699.
[15]Proc. U. S. Nat. Mus. XVI, 709.
[16]Proc. Nat. Mus. XVI, p. 691.
[17]Proc. U. S. Nat. Mus. XVI, 758.

EMBRYOLOGY.[1]

Development of Sponges.[2]—Otto Wass in a comprehensive paper describes the egg development and metamorphosis of several representatives of the Cornacuspongiae, including under this head the Monaxonida, with the exception of the Clavulina and the horny sponges. For the Monaxonida the embryonic development of *Myxilla* and *Chalinula*, and the metamorphosis of *Axinella* and *Gellius*, are described in detail. For the horny sponges, the development of *Euspongia* and *Hircinia* is outlined. In addition, there are scattered observations on many other Naples cornacuspongiae, and lastly the author presents the results of a renewed study of *Spongilla*.

A fundamental uniformity both as regards embryonic development and metamorphosis, was found to prevail throughout these sponges. The account of the metamorphosis differs but little from the author's previous account of the metamorphosis of the *Esperia* larva, and is very similar to that given by Yves Delage in his last paper (reviewed in the January NATURALIST).

In the marine monaxonida described, the segmentation is unequal. Micromeres in an epibolic fashion surround a mass of macromeres, except at the posterior pole. The micromeres become the ciliated epithelium of the larva, the macromeres constitute the inner mass. The larva thus consists of two layers. In the inner mass some of the cells remain undifferentiated, while the rest alter both in nucleus and cell body, and are collectively known as differentiated cells. Certain of these differentiated cells arrange themselves in an epithelial manner at the surface of the posterior pole. The undifferentiated cells of the inner mass become the amoeboid cells of the adult, from which the reproductive elements are developed. Thus the division into germ and somatic cells is very early brought about.

In the horny sponges the segmentation does not lead to a true morula which dilaminates into an outer layer and an inner mass, as Schulze thought. The segmentation here too is unequal, and the micromeres surround the macromeres as in the monaxonida, the former becoming

[1]Edited by E. A. Andrews, Baltimore Md., to whom communications may be addressed.

[2]Die Embryonal Entwicklung und Metamorphose der Cornacuspongien, von Dr. Otto Wass, Zoologische Jahrbücher. Abth. für Anat. und Ontogenie. Bd. VII, 2 Hft., 1893.

the ciliated epithelium of the larva, the latter the inner mass. But in the larva of the horny sponges, as in that of *Spongilla*, the ciliated epithelium is continuous over the whole surface. This is explained by supposing that in these types the ciliated epithelium (micromere layer) completes its growth around the inner mass, which in the other sponges is left bare at the posterior pole.

In the metamorphosis of the two-layered larva of the cornacuspongiae, a complete inversion of the layers take place. The ciliated cells draw in their cilia, and migrate into the interior of the sponge where they form a compact mass, surrounded by the former inner layer. Certain of the differentiated cells of the latter layer unite to form the thin epidermis of the adult. The boundary line between the rest of this layer and the inner mass of once ciliated cells gradually disappears, elements belonging to both layers becoming distributed irregularly throughout the sponge body (process of "durchwachsung"). Groups of the ciliated cells now begin to develop into flagellated chambers. Independent spaces or lacunae appear and become gradually lined with an epithelium formed by the differentiated cells of the larval inner layer. These spaces are the canals. Connection between them and chambers is subsequently established. In two points Wass differs from Delage, in his account of the metamorphosis. Delage believes a special layer of cells, the epidermic cells, can be distinguished in the larva, which during the metamorphosis, take the place of the ciliated cells as a superficial covering. Wass finds no ground for distinguishing the cells which thus form the adult epidermis, from the other differentiated cells of the larval inner mass. Again Delage believes that during the metamorphosis the undifferentiated cells engulf, amorba like, the smaller ciliated cells, subsequently letting them go free to form the flagellated chambers. Wass disbelieves in this remarkable process, though he grants the possibility of amoeboid cells occasionally engulfing ciliated cells, which however are never after liberated, but undergo degenerative changes (i. e. are digested).

On going over the *Spongilla* development the author, aided by his discoveries in marine sponges, finds that a different interpretation in many particulars is to be put upon his earlier observations. The segmentation is not equal, but unequal. A true morula is not established, but instead the smaller blastomeres surround the larger. The ciliated epithelium of the larva is not transformed into the adult epidermis, but the inversion of layers described above takes place in *Spongilla* also. The exhalent canals and flagellated chambers are not formed as diverticula from a single main cavity, nor are the inhalent canals form-

ed as invaginations of the "ectoderm," but both sorts of canals arise as independent lacunae, subsequently acquiring an epithelium and connecting together, and the chambers are formed from groups of the immigrated cells. The development of *Spongilla* is thus brought into accord with that of the marine cornacuspongiae.

In a comparative review of the various types of sponge development, the author points out the fundamental similarity between the development of the cornacuspongiae and that of the calcareous sponges, as exemplified in *Sycandra*. The ciliated cells are homologous in the two kinds of larva, as are the granular cells of the amphiblastula and the inner mass of the other larva. The difference in the character of the metamorphosis arises from the fact that in the amphiblastula there is a large cavity, while in the larva of cornacuspongiae there is none. In this comparison Wass and Delage agree.

The author thinks the development of those sponges (*Ascetta*, *Oscorella*, *Plaxira*, etc.), which apparently differ from the plan of development described in this paper, needs to be worked over. A fundamental harmony with the development of cornacuspongidae and *Sycandra* will be revealed.

Touching the relationship between sponges and the other metazoa the author, without dogmatizing, is inclined to believe that they had a common ancestor above the protozoa. This ancestor is represented in the two-layered larva of both. But the community of origin goes no higher than this simple form—the sponges are not coelenterates. In the two-layered ancestor of the sponges, the superficial ciliated cells migrated into the interior, resigning their function of locomotive organs in order to generate internal currents of water, made necessary by the adoption of a fixed habit of life with subsequent increase of bulk. In other metazoa, the ciliated cells continue to form the superficial covering of the body. The immigration of the ciliated cells in the larva of cornacuspongiae, and the invagination of the ciliated cells in the Sycandra amphiblastula, are the ontogenetic expression of this change of position of the ciliated cells in the early ancestors of sponges, and have nothing to do with a process of gastrulation—the two-layered embryo being already formed before the occurrence of this immigration or invagination.

H. V. Wilson.

ENTOMOLOGY.[1]

Shade Tree Insects.—Professor H. Garman[2] publishes an excellent account of the pests of shade and ornamental trees. The article is chiefly concerned with insect pests, which are roughly divided into three groups: (1) Leaf insects, (2) trunk and branch mining insects, and (3) root infesting insects. To the first group belong the largest proportion of species, the walnut-worm, web-worm, elm leaf-bettle and others being included in it. "Such insects attract attention at once from the nature of their injury, the unsightly appearance due to gnawed leaves, webbing and refuse, taking away at once from trees their practical value as shade, and their æsthetic value as ornament.

"While their injuries are not at first so apparent, the work of the boring and mining species is not less injurious, and is the more to be feared because its results are not seen until the mischief under the bark is at an advanced stage. The locust borer and the elm bark-beetle are members of this group, both species being common and injurious in Kentucky. The pine bark-beetles and the fruit bark-beetles now becoming injurious in this State may also be placed here. The greater number of species which attack the trunk are the grubs of beetles. A few are caterpillars (larvæ) of moths. The branches and twigs are injured by a host of small species, some of which girdle them, others mine them, still other species do serious mischief by placing their eggs in them, while some of the true bugs simply puncture and abstract their sap.

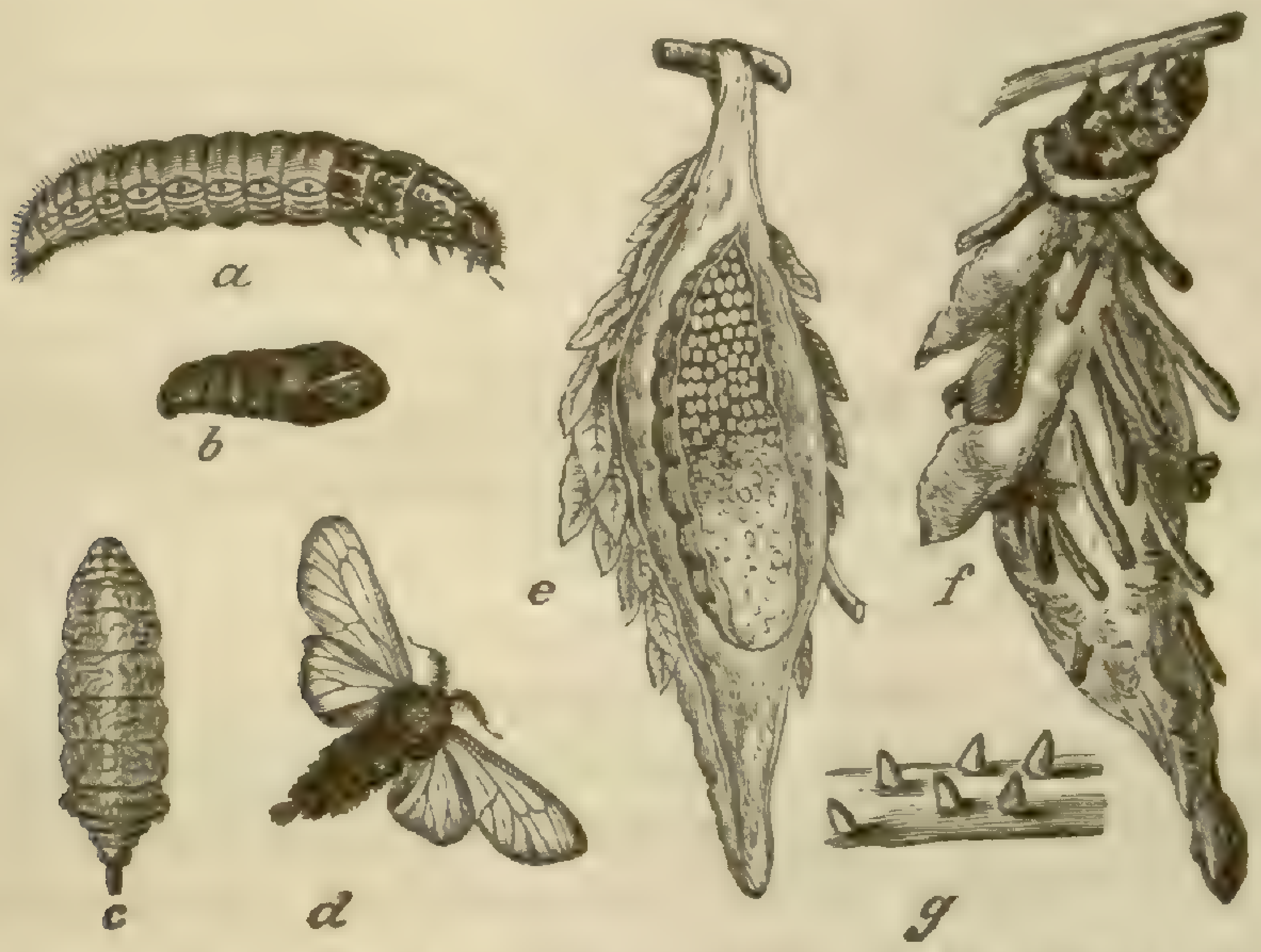
"Doubtless the number of insects which feed on the roots of shade trees is large, but the unavoidable difficulties in the way of studying their habits has prevented a very full knowledge of this group."

Mr. Garman treats of the life-histories of the species most destructive in Kentucky at some length. The bagworm is one of the first discussed. This worm "lives in and carries about with it a case made of silk, on the outside of which it fastens bits of leaves, probably to render its detection less easy to birds and other enemies. One may see these cases all through the winter adhering to the naked twigs of both deciduous and evergreen trees, the worms having taken the precaution to fasten them there by wrapping the twigs with silk. The case of a grown worm measures 1.75 inch in length and its greatest diameter is some-

[1]Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2]Bulletin No. 47, Kentucky Agr. Experiment Station.

what more than .50 inch. If cases are examined during the winter a large number will be found empty, these being old ones which adhere to the twigs longer than one season, or else are those which produced males. In every one which produced a female the preceding summer will be found an oblong brown cylindrical object tapering a little at one extremity, but blunt and with a ragged opening at the opposite end through which the adult insect escaped; for these are the deserted pupal skins of the female. Each appears at first to be full of a powdery material, but on removing some of this the minute soft whitish eggs will be observed packed closely so as to fill the greater part of the skin.



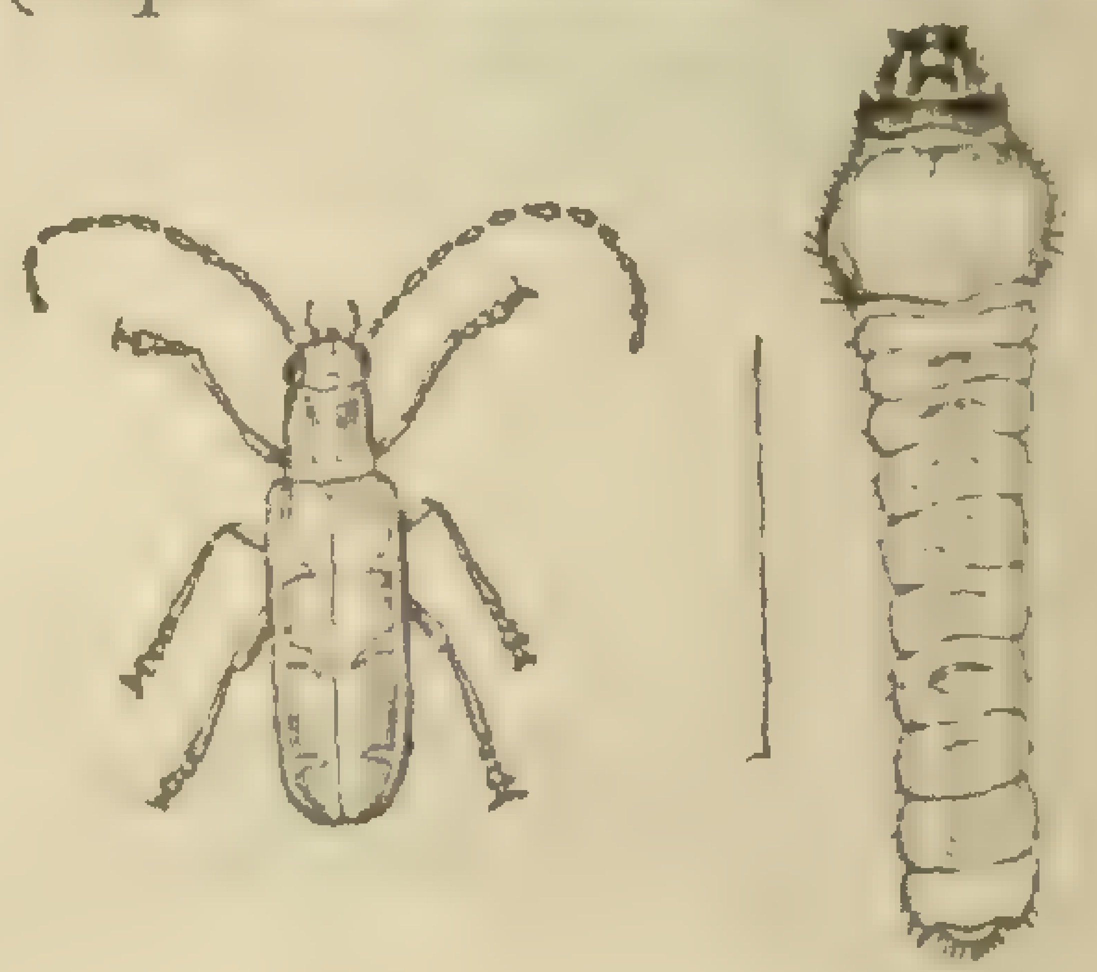
The bag-worm. *a*, larva; *b*, pupa; *c*, adult female; *d*, adult male; *e*, bag containing eggs; *f*, bag containing larva; *g*, young larvæ, with conical cases. (From Riley).

"The adult female of the bag-worm is a very singular creature, looking more like a worm than a moth, incapable of flight, having no rudiments of wings, and with only minute and functionless legs. The very scales of the greater part of her body are abortive, and are rubbed off to constitute the powdery material in which the eggs are packed. Being incapable of flight the most she can do is to wriggle down to the opening at the lower end of her case where she meets the winged mate, and then in the same manner wriggles back to her empty pupa case in which she carefully placed her eggs for safe-keeping during the winter. Finally with an astonishing solicitude for the walfare of her prospective young, she deserts the case, drops to the ground, and dies shortly afterward. Is it possible that this pulpy mass, exhausted, with nothing more to live for, with death certain and at hand, understands

that a dead and putrid body left in the case would work harm to her precious eggs? Anyway she leaves the case."

Mr. Garman photographed a member of the cases from different trees, as shown on the accompanying plate. Those marked *a* are from red cedar; *b*, from maple; *c*, from arbor vitæ; *d*, from spruce; and *e* from white pine.

An extended account of the elm borer (*Saperda tridentata*) is also given. This insect had done serious injury to some of the largest and finest elms in the city of Frankfort. The nature of the damage is well-shown in the plate reproduced herewith. Washing the bark with a mixture of whitewash and Paris green is suggested as a preventive measure.



Elm-borer: larva and adult.

Larval Habits of Brachinus.—Mr. H. F. Wickham records (in the Canadian Entomologist) finding in northern Iowa the larvæ of a species of Brachinus parasitic on the pupæ of *Dineutes assimilis*. "The larva lies in the cell of its host and extracts the juices from an opening made in one of the wing-pads; the maggot-like body is adorned, but not supported by six very soft and short legs, which can be of little service except perhaps as 'feelers' in its dark abode. The little animals were carefully watched and examined several times a day, until finally the larger one, having withdrawn nearly all the juices from the pupa and become swollen to an unwieldy size, changed after a day or two of resting into a pupa.

"How the Brachinus gets into the cell of it host, whether brought in as a young larva clinging to that of the Dineutes, or deposited as an egg by the mother is a mystery to me. When small it is more active than when larger grown, and with advanced age becomes gradually more helpless. In any case the complete adaptation to a parasitic habit is apparent in the whole structure—the soft, juicy body, unprotected by chitinous scutes, the weak legs quite useless for ambulatory purposes, and the lack of strong locomotive bristles. The appearance is almost that of some Hymenopteron, not at all resembling the strong raptoreal larvæ of the Adephaga in general."

North American Trypetidæ.—Mr. W. A. Snow makes an important addition to our knowledge of a little-studied family of Diptera

in his descriptions of North American Trypetidæ, with notes.[3] Good descriptions of a large number of new species are published, together with valuable notes on the distribution of those already known. Two new genera—Polymorphomyia and Xenochæta—are characterized. Two plates illustrate the wing markings of many species.

North American Dolichopodidæ.—Professor J. M. Aldrich in his New Genera and Species of Dolichopodidæ[4] describes five new species, and characterizes two new genera—Dactylomyia and Metapelastoneurus. He also gives a table of the species of Sympycnus.

Entomological Notes.—At a recent meeting of the Entomological Society of London Mr. S. H. Scudder "exhibited the type-specimen of a fossil butterfly—*Prodryas persephone*—found in beds of Tertiary Age at Florissant, Colorado. He said the species belonged to Nymphalidæ, and the specimen was remarkable as being in more perfect condition than any fossil butterfly from the European Tertiaries. He also said that he had found a bed near the White River on the borders of Utah in which insects were even more abundant than in the Florissant beds."[5]

K. T. Nogakushi of the Imperial University, Tokio, publishes[6] a preliminary notice of his investigations of the Spermatogenesis of *Bombyx mori.* The author distinguishes four zones in the follicles: the formative, growing, ripening, and that of metamorphosis.

At a recent London sale a specimen of *Chrysophanus dispar* sold for six pounds, ten shillings; and a pair of *Noctua subrosea* for six pounds six shillings.

In his report as Dominion Entomologist for 1893, Mr. James Fletcher discusses a large number of injurious insects affecting various Canadian Crops.

[3] Kansas University Quarterly, II, 159–174; Jan., 1894.
[4] L. c. 151–157.
[5] Ent. Mon. Mag., V, 22.
[6] Zool. Anzeiger, XVII, 20.

ARCHEOLOGY AND ETHNOLOGY.[1]

The non existence of paleolithic culture.—There appeared in the January number of THE AMERICAN NATURALIST a criticism by Mr. H. C. Mercer of my recent paper " On the Evolution of the Art of Working in Stone," which induces me to ask for space for an answer.

My paper in the *Anthropologist* for July 1893 was necessarily restricted, and, although only a preliminary one, had I thought, made some points clear in the discussion of paleolithic man which appeared to me not to have had particular attention drawn to them.

Geology, anatomy and prehistoric archeology are all of the greatest value in the study of the early history and development of the human race, but a study of the technology of archeology, I contended is equally important in determining the mechanical status of the race at any period of its existence.

(1) I contend that "Teshoa or chip-knife" making at one blow, or making a "turtle back" at twenty blows (if turtle back is all we want), may be as easy as, but is not *easier*, than hammering and grinding. The present status of archaeological information fully justifies the expression of a doubt that either a "teshoa" or "turtle back" is a completed instrument.

(2) That Pottery is recorded as found in the lower European cave strata, (and the authorities who make the assertion are fully sustained) " warrants a review of the French classification."

(3) " Why " Says Mr. Mercer " men who bored, polished and carved bone, sketched realistic designs, and chipped blades equal in make to Mexican sacrificial knives did not polish stone, seems incomprehensible. But the European museums clearly assert that no polished stone tool has been found in the caves. If true, the fact is conclusive against Mr. McGuire."

One of the chief points which my paper raised was, that the ability to do these things (bone polishing etc.) was sufficient proof of itself that those who did them could and did polish stone tools, and further, such polishing required less acquaintance with the fracture of stones, simpler tools, and less technical ability, than was necessary in chipping and flaking stone, and in scraping and etching bone, etc.

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

I do not deny that the hammer was used for many different purposes, but assert that its shape proves it to be intended for stone working, and not for corn bruising.

(4) I think that this is answered under No. 1. I deny that the "Coup-de-poing" materially differs from the "turtle-back." Both are apparently unfinished implements. The "turtle-back" presents its refractory part in a ridge down the center of a proposed implement. The refractory part of a "coup-de-poing" is on its periphery, and is generally due to a knot in the stone. No two stones have the same fracture; the same stone will show a variety of fracture in a given vein.

(5) Polished implements have been found in the caves also in the clays, and in the bogs; in localities entitling them to be classed as of the quaternary period with as much claim of right as any chipped stone.

(6) Admits that pottery is not to be expected in the drift.

The admission that European cave classification requires revision carries with it the admission that it is erroneous.

I fully realize that it is considered by a very large class of archeologists as heterodox, to deny the existence of a paleolithic period. The classification of paleolithic periods into those of St. Acheul, Chelles, Mousterian, Magdalenian, etc., is demonstrably inaccurate, and needs revision and simplification. The advocates of paleolithic man assert that his mechanical development was so low, that the only stone work which he was capable of performing, was to knock flakes from stones with a few blows at most and subsequently to use them as cutting implements, by holding them in the naked hand, yet they admit that while he was in this low stage of mechanical development he was possessed of artistic attainments, and that he could and did etch or engrave the representations of animals on stone, bone and ivory and that he could at this time make the gravers and other tools which such work required.

They further assert that he went through a distinct period extending over centuries, in the gradual development of the art of chipping stone, until finally he made chipped implements of exquisite shape which cannot now be duplicated. At the time when he had scarcely learned to chip rough flakes on one side, it is shown that Paleolithic man made needles of bone with eyes carefully drilled through them, that he made bone pins and ground them, that he fashioned spear heads of bones with barbs or opposite sides, that he possessed organized government and recognized in the Batons-de-Commandment the insignia of rank; these articles being found with an arctic fauna necessitate the

admission that he was sufficiently clothed to resist the cold, if so, he must have possessed fire and shelter, all of which would require intelligence. It cannot be denied that with such weapons as he possessed, he successfully attacked a fauna more powerful, and presumably more ferocious, than any now known to man. Man cracked the bones of these animals, and had, it is asserted, a particular shape of spoon with which to extract the marrow, yet it is seriously argued that man in a cultural state such as indicated, had not learned the art of rubbing one stone against another in order to give it a cutting edge, but did rub one piece of ivory on a stone to smooth it for the reception of an engraving on it of a mastodon. Ivory is little at all softer than certain of the stones from which the so-called Neolith was often made. My experiments and my reason and every hour's work I have done, convince me that with our *present* data no one has the right to divide the stone age into a chipped and polished age, much less to divide the chipped age as has been done. The argument has no reliable evidence to support it.

I am sure I will be judged leniently when I claim that an intelligent study of archeology depends for its value upon some different classification than now sustains it.

Whether such classification can be made upon some such basis as was laid down twenty years ago by Prof. Otis T. Mason, or (if the classification is to be confined to stone implements alone,) whether that of DeMortillet or of Holmes will develop in the most valuable hypothesis, I cannot say. I am inclined, however, to believe in that of the latter, if there be added to it an arrangement to study the handles of implements, the development of attachment of the same, and the rapidity with which they may be worked, for the working part of most implements show little change in form from the earliest known.

J. D. McGuire.[3]

Professor W. Boyd Dawkins on Paleolithic Man in Europe. —How much Prehistoric Archeology leans upon Paleontology has recently been shown by Prof. W. Boyd Dawkins (Journal of the Anth. Inst. of Grt. Britain and Ireland, Feb., 1894, p. 242) in a comparison, by fossils and human remains, of the two great divisions of prehistoric time in Europe. He thus compares them:

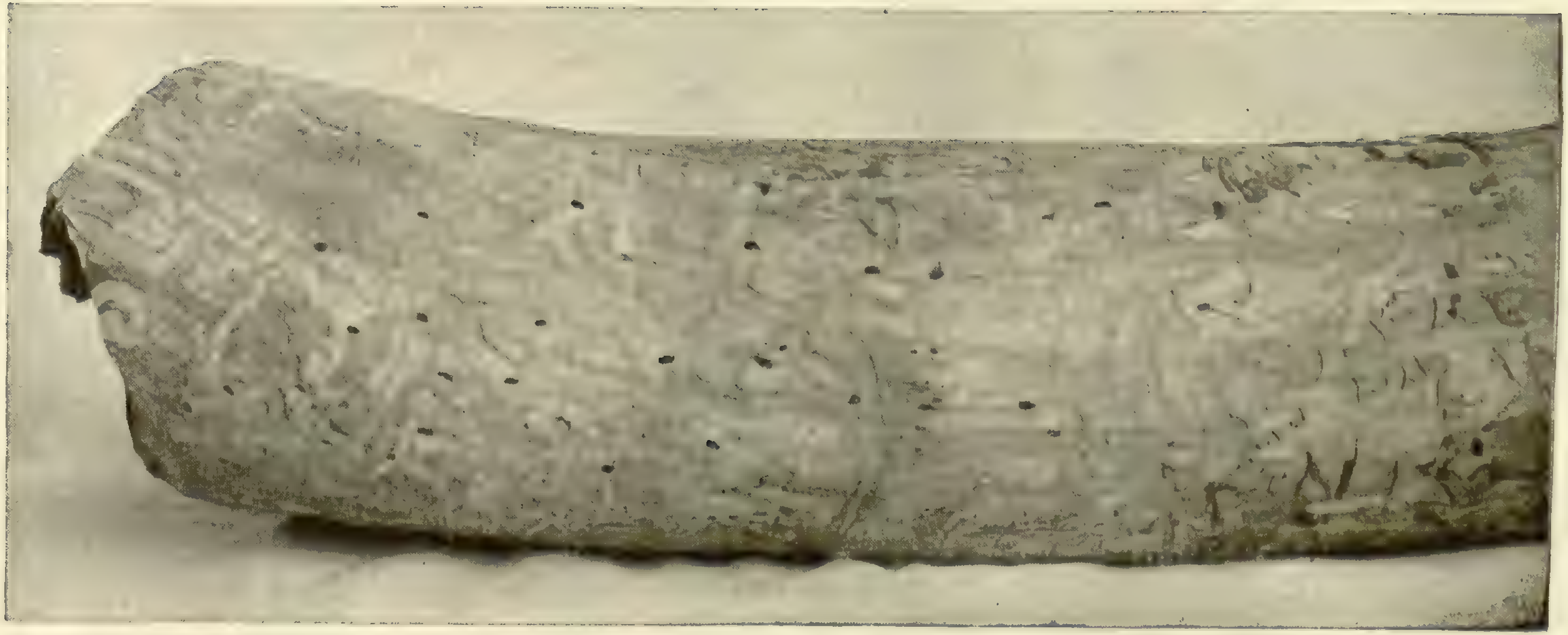
(a) The earlier period, called *Paleolithic*, now cold, now hot, of the Hippopotamus, Mammoth, Rhinoceros, Musk Ox, Reindeer, Cave Hyena, Cave Lion and Cave Bear, with man a nomad hunter lacking all domestic animals, who chipped but could not polish stone, and

[3] Of the Smithsonian Institution, Washington, D. C.

PLATE XI.

Bag-worm cases on various trees.

PLATE XII.



Elm with bark removed, showing injury by borers.

(b) The later time, called *Neolithic*, of still existing species and climate, with man an agriculturist possessor of the dog, goat and hog, who chipped and could also polish stone and make pottery.

Prof. Dawkins passes by the questioner who might here ask whether the first described man was really paleolithic, and accepts without hesitation the two custom honored titles, Paleolithic and Neolithic, as labels for his paleontological periods.

But if M. Dupont found the celebrated earthen bowl along with boar, horse, urus, chamois, goat, wildcat, hare, beaver, and reindeer bones, in the Trou du Frontal (on the Lesse near Furfooz) and at the Engis Cave (near Liege), a potsherd at the same spot where Dr. Schmerling had found his "Philosopher's" skull along with Mammoth, horse, hyena and bear bones in 1833; and if a bit of pottery was really found in the layer of cave bear, cave lion, rhinoceros, hyena, bison and mammoth bones, at Surignac Cave (Haute Garrone, France), after a farmer named Bonnemaison had mixed up the layers and lost the human bones; if pottery was found in the alleged paleolithic caves of Nabrigas (Prof. Joly), Vergisson (M. Fery), and Trou Rosette; and if MM. de Puydt and Lohest found three burned potsherds about nine feet down in the La Biche aux Roches Cave (near Spy, Belgium), under elephant and rhinoceros bones; then the word paleolithic, devised to signify an early non-pottery-making, non-stone-polishing stage of human culture, would lose mnch of its meaning.

Sir John Lubbock, when called upon to defend his word and its notion that man chipped a long time before he polished stone, cannot look for support to the flaking Australians, who, in the Kamalarai Country, used a ledge of sandstone rock as an axe polisher (Frazer's Aborigines of New South Wales, Sydney, p. 76) and often ground tomahawks and grooved axes (Brough Smith's Aborigines of Victoria, 1, p. 366, figs. 177, 178, 183, 189); though he may, it seems, look to the recently (about 1850) extinct Tasmanians, who never appear to have polished or got beyond chipping stone tools that resemble what M. de Mortillet calls Mousterian flakes.

It is the paradoxical mixing of the fauna of the above named earlier or paleolithic time in Europe that chiefly interests Prof. Dawkins and would call for such explanations as alternate periods of heat and cold, as hippopotamus and reindeer migrations, and as the preservation of animal carcasses in ice as food for later carnivora; to account for certain caves where, to the confusion of the naturalist, the bones of the boreal Mammoth and tropical Hippotamus are mixed together,

and heat loving spotted hyenas have gnawed the fresh bones of the arctic reindeer.

Puzzles like these may be finally explained by the study of such superposed plistocene layers as those of Abbeville, which, according to M. G. d'Ault du Mesnil, indicate that the fauna grew newer and a warm climate became colder as we approach the latest bed, as follows:

Somme Gravels, Abbeville.

(a) Upper Terrace (oldest).

Elephas antiquus, E. primigenius, Rhinoceros merkii, R. tichorinus, Hippopotamus major, Ursus speleus, Cervus megacerus, Hyena spelæa, Machærodus cultridens, Trogontherium cuvieri, Equus caballus, Bos primigenius.

(b) Middle Terrace.

Elephas antiquus (declining), *E. primigenius, R. tichorninus* (increasing), *Equus caballus, Cervus elaphus, Bison priscus, Rhinocerus merkii* (declining), *Hippopotamus major, Ursus speleæus, Cervus megaceros, Hyæna spelæa, Machærodus cultridens, Trogontherium cuvieri, Equus caballus, Bos primigenius.*

(c) Lower Terrace (latest).

Elephas primigenius, Equus caballus (dominant), *Rhinocerus tichorinus* (numerous), Reindeer, *Cervus elephus, Cervus tarandus, Bos primigenius,* Ursus (not determined) and *Cyrena fluminalis.*

Turning to the associated human remains, in Prof. Dawkins' first period, cave runs into cave and rock shelter into Drift so unclassifiably that we had better, he thinks, stop subdividing the epoch into Drift, Mousterian, Solutrian and Magdalenian, and call it all by one name, Paleolithic.

But while objecting to breaks in his Paleolithic, the sharp break between it and the Neolithic is his main point. As no grading together of fossil remains bridges over this gulf, so, he thinks, (spite of pottery rumors from paleolithic caves) that the human relics of period a, and period b, show a corresponding hiatus.

The few Drift-like chipped blades, produced at the Institute meeting from the (period b) Cissbury neolithic quarry were easily explainable as inchoate celts and wastrels, and the fact of their looking like (period a) Drift specimens was enough to call a halt to the surface gatherer and the labeller by type and, we might add, clear the

museums of Europe of many hastily classified "paleoliths." Perhaps this was the same kind of Drift likeness that I had observed in April, 1893, among the ruder incipient forms at the (period b) Neolithic quarry of Spiennes in Belgium (The Archæologist, July, 1893. Am. Naturalist, Nov., 1893). But at Spiennes as at all other quarries that I have studied and mutually compared, it is evident that the *results* of each blade maker's workshop, by which alone we can explain the wastrels, must be first understood. Whatever the similarity between Neolithic Cissbury and the paleolithic Drift (and the British Museum specimens show none) neolithic Spiennes does not come much nearer the paleolithic drift workshop of Abbeville, through the similarity of rudest wasters in either case, than it does to Flint Ridge, Ohio.

If Prof. Dawkins recognizes no human chipped implement grading out of his Paleolithic period, so he will not with Prof. Prestwich allow the work of a more primitive alleged predecessor of the Drift man to grade into it, holding that the variously nicked flints "Plateau implements" found by Mr. B. Harrison on the high Kentish downs are of Drift and not pre-Drift age. But he does not clearly say whether he thinks that these curious specimens are blade refuse, finished implements or, as Mr. W. G. Smith of Dunstable (who writes me that he has found many in the Drift-blade bearing gravels at Caddington) regards them, the work of nature.

Prof. Dawkins showed also at the meeting a good example of a modern "paleolith," a North American Indian soapstone quarry pick, and with it a stone tool very modern yet simpler in form than any paleolith, one of Dr. Leidy's much ignored and often misunderstood "teshoas," seen used by Utes, together with a set of Trenton specimens obtained by Prof. Dawkins and which he said should, with their fellows collected by Dr. Abbott and Professors Putnam, Haynes, Morse, Carr, and Shaler, be placed, until further proof be furnished, in a suspense account.—H. C. Mercer.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—This body met in Washington, D. C., April 17th. The following papers were read. I. Histological Characteristics of Certain Alpine Plants, G. L. Goodale. II. Corrosions by Roots, G. L. Goodale. III. An Investigation of the Aberration and Atmospheric Refraction of Light, with a Modified Form of the Loewy Prism Apparatus, George C. Comstock (Presented by S. Newcomb). IV. Biographical Memoir of John Le Conte, Joseph Le Conte. V. The Coral Reefs of the Bermudas, A. Agassiz. VI. The So-called Serpulæ Reefs of the Bermudas, A. Agassiz. VII. The Bathymetrical Extension of the Pelagic Fauna, A. Agassiz. VIII. New Method of Determining the Relative Affinities of Certain Acids, M. Carey Lea. IX. On the Change of Young's Modulus of Elasticity with Variation of Temperature, as Determined by the Transverse Vibration of Bars of Various Temperatures, A. M. Mayer. X. On the Production of Beats and Beat-tones by the Covibration of two sounds, so high in pitch, that when separately sounded they are inaudible, A. M. Mayer. XI. On the Motions of Resonators and Other Bodies Caused by Sound Vibrations, with Experimental Illustrations; also a Reclamation, A. M. Mayer. XII. On Late Researches on the Variation of Latitude, S. C. Chandler. XIII. On the Infra-red Spectrum, S. P. Langley. XIV. The Bacteria of River Water, J. S. Billings. XV. The Influence of Light Upon the Bacillus of Typhoid, and the Colon Bacillus, J. S. Billings. XVI. Recent Gravity Instruments and Results, T. C. Mendenhall. XVII. The Geographical Distribution of Fishes, Theo. Gill. XVIII. Note on a Possible Increase in the Ultimate Defining Power of the Microscope, C. S. Hastings. XIX. The Internal Energy of the Wind, S. P. Langley.

No election of members was had. The Academy discussed a plan of division into classes without reaching a definite conclusion.

Natural Science Association of Staten Island, Februry 10, 1894.—Mr. William T. Davis exhibited specimens of the seventeen year locust found in various years since 1877, and read the following paper.

THE SEVENTEEN YEAR LOCUST ON STATEN ISLAND.

Our island will resound with the rattling song of the seventeen year Harvest fly or "Locust," during the latter part of next May and in

the month of June, and it may not be uninteresting in view of the fact, to give a short account of the species in connection with this locality. It must be borne in mind that while *Cicada septendecim* Linn. appears at intervals of seventeen years, its advent is not in the same year in all of the middle states, or in all the counties of this State, but that there are separate broods or colonies, that emerge in great numbers in districts of varying extent, the limits of which are not sharp or well defined. Thus it happens that while there is a certain brood that appears periodically on our island, and attracts at such times general attention, there are also other years when the *Cicada* occurs in small numbers. At such times it will often be found that a brood is emerging not many miles away, and that the island lies within the outer margin of the territory.

This matter of distribution and much more regarding the seventeen year *Cicada*, and the more southern thirteen year form, has been recorded by Professor Riley in Bulletin No. 8 of the U. S. Department of Agriculture, Division of Entomology. Professor J. A. Lintner, New York State Entomologist, also gives, in his second annual report, the distribution of the *Cicada* in this State, noting five broods as occurring within its limits.

In 1826 this *Cicada* appeared in great numbers on the island, as I have been informed by my grandmother; in 1843 they came again, as recorded by Thoreau, and still again in 1860 and in 1877. In the latter year I saw many tree trunks and fences brown with their cast pupa skins, and the whir of their flight and monotonous song, could be heard in every direction. Dr. Fitch, in 1855, wrote of the seventeen year *Cicada* and records this brood as inhabiting the valley of the Hudson River. Since his time, the various broods in different parts of the country, have been numbered for convenience, and the one inhabiting the valley of the Hudson and Staten Island, is known as No. XII.

During the visitation of 1877, I noticed that many of the *Cicadas* were affected by the singular fungus *Massospora cicadina* Peck. While the insects were alive and walking about the fences and the tree trunks, if the abdomens of the infected individuals were suddenly jarred, they gave forth a cloud of innumerable spores. It has been stated that only injured specimens are attacked by this fungus, and then only toward the latter part of the season.

Since 1877, the seventeen year *Cicada* has not appeared on the Island in great numbers, and probably but few have been noticed except by those who have looked for them. The facts connected with

appearance, as far as known to me, may be arranged chronologically as follows:

1881, BROOD XVIII.

While collecting insects with Mr. Leng in the neighborhood of Watchogue, we found a red-eyed *Cicada* pupa under a stone, and on the 5th of June, eight specimens were collected, many of them being wet, having but recently emerged. By the 12th of June, they had become quite numerous, and I counted about one tree near Silver Lake, fifty-two pupa skins. The brood to which these insects belonged does not appear in great numbers in the east, but is mainly located in Wisconsin and the neighboring States. Staten Island, Essex Co., New Jersey, and Germantown, Penna., were apparently, the only eastern localities from which the insect was reported in 1881.

1885, BROOD XXII.

I made special search this year for the Periodical *Cicada*, as one of the most widely extended broods known, was to make its appearance. On the western end of Long Island in the neighborhood of Brooklyn, they came in some numbers, and also sparingly in New Jersey, the main body in the east, however, occuring in Pennsylvania and thence southwestward.

On the Island the insects must have been quite scarce. Mr. James Raymond and I, were walking along a wood-path in the Clove Valley on the 4th of July, when we found a wing that probably some bird had pulled off a red-eyed *Cicada*, as they so often do. To those who are acquainted with the character of the wings of this insect, their colors etc., this will constitute ample authority for its presence. In the autumn, an old pupa skin was collected, and the following April, another was found at South Amboy, New Jersey.

1888.

On the 16th of June while in the valley of Logan's Spring Brook I heard a *z-ing* in the distance like that produced by the seventeen year *Cicada*. As it stopped shortly and was not repeated the search was abandoned. Eight days later, when by the same brook the song was again heard, and this time followed to apparently the same tree from whence it came on the previous occasion. After some search the insect was detected on the under side of the limb, and captured. One of its fore wings was deformed so that it was unable to fly, and of course must have been born in the immediate vicinity. This was the only individual seen during this year.

1889.

Brood No. VIII was expected to appear in southern Massachusetts, on Long Island and in parts of Pennsylvania and West Virginia in the summer of 1889. It returned, according to a note in Vol. 1, No. 4, of the Proceedings of the Entomological Society of Washington, in considerable numbers in parts of North Carolina and West Virginia, and in less numbers in the District of Columbia, Maryland and New Jersey.

The only evidence that the seventeen year *Cicada* occurred on Staten Island in 1889, consists of a pupa skin found on a grass stem during the summer by Mr. Jos. C. Thompson, and kindly given to me.

1890.

During this year the *Cicada* was not expected to occur in any part of the country. In June and July, I found in a garden in New Brighton, three pupa skins, and my sister discovered one of the perfect insects on the trunk of a pear tree, but it was unfortunately destroyed by the family cat. Mr. Leng also found a red-eyed *Cicada* on an apple tree near the Moravian Cemetery, while he was "beating" for Longicorns.

On the 8th of September 1890, I found, in a hill of potatoes, a live red-eyed *Cicada* pupa, which I endeavored to rear, but without success.

1892.

On June 5th, I heard a seventeen year *Cicada* at West New Brighton, and the next day Mr. Leng's children caught me a specimen, and a few days later a second example. On the 11th of June there were many of the *Cicadas* singing in the high trees about Logan's Spring Brook, and on the 12th, I heard one near Rossville.

1893.

On June 11th, the *Cicadas* were fairly numerous in the woods along Willow Brook, and later in the month I heard them along Logan's Spring Brook. Mr. Leng's children also gave me two specimens from his garden at West New Brighton.

It is well-known that a few seventeen year *Cicadas* often make their appearance in the year previous to their general visitation, so that those collected in 1893, and even in 1892, may have been precursors of the general swarm which is to come early next summer, that is, seventeen years from the visitation of May and June, 1877.

March 10.—Mr. L. P. Gratacap exhibited pieces of a drift bowlder containing fossils, and read the following paper:

ADDITIONS TO THE DRIFT FOSSILS OF STATEN ISLAND.

These specimens represent the remainder of one of the bowlders found by Mr. Arthur Hollick, at Prince's Bay, last autumn, mentioned in our Proceedings for Nov. 11, 1893.

The rock is a lower Helderberg limestone, somewhat crystalline and shaly, and affords numerous fossils, conspicuous among which is *Stropheodonta varistriata* var. *arata* Hall, a fossil brachiopod characterized by a very convex ventral valve and by prominent ribs, which are scored by numerous delicate striae, easily discernible under a low magnifying power. This fossil assumes some importance, in its numerical representation, in the lower Helderberg beds of Becraft's Mountain, east of the Hudson River, in Columbia Co., and the most easterly exposure of the Helderberg series of strata in New York State. It seems safe, from this fact, and a close lithological similarity in the material of the bowlders with the Becraft stone, to conclude that this "wanderer" commenced its travels southward from that distant point. Associated with it are a few lamellibranchs, which are seen less commonly in our drift material, and were actually less important elements in the Helderberg Sea. These are *Pterinea communis* Hall, *Pterinopecten bellula* Hall, and *Aviculopecten umbonata* Hall, all new to the Island. Upon one of these *Pterina communis* there is the half effaced trace of a pygidium or tail of *Lichas bigsbyi* Hall, a trilobite and a not common species, usually found in separated heads and tails. Its identification as *Lichas* is unquestionable, but in the complete absence of any considerable evidence, from the poor nature of the specimen, it is not certainly separated from *L. pustulosus.* If *bigsbyi*, as is probable, it also indicates Becraft's Mountain as its origin. Amongst the brachiopodous remains in these fragments we find *Rensselœria mutabilis* Hall, *Meristella bella* Hall, and *Orthis eminens* Hall, all new in our Island finds. Besides these molluscs there are seen, in these fossil remains, plain and broad sheets, or fronds, of the bryozoan *Lichenalia*, showing both the poriferous and non-poriferous surfaces. The species I am unable at once to determine. Besides this there is a fenestrated polyzoan, *Fenestella œsyle* Hall, as far as I can fix on its specific nature. The heteropod *Platyceras gebhardii* Hall is another new species, although this reference may be doubtful, as in this genus of shells the species run insensibly into each other and the present multiplication of these specific names seems provisional.

Amongst these specimens are two Oriskany sandstone species, *Rensselæria ovalis* and *Platyceras nodosus*, which were detached by Mr. Hollick from the same bowlder which yielded the Helderberg fossils. This places the rock in the upper Lower Helderberg strata, probably the Upper Pentamerus beds, and exhibits the faunal emergence of the life of the Oriskany Ocean. This find illustrates still further, if illustration was necessary, the paleontological importance of our drift material and provides additional incentives to further investigation.

Mr. Thomas Craig exhibited a living myxomycete under the microscope and read the following paper:

SOME OBSERVATIONS ON THE BEHAVIOUR OF A MYXOMYCETE.

In Bennett and Murray's book on Cryptogamic Botany mention is made of this form of life as the sixth sub-division. It is placed between the fungi and the protophyta; but at the end of their description they say: "We are justified in placing these organisms outside the limits of the vegetable kingdom."

Dallinger, in his edition of Carpenter on the Microscope, places them in the animal kingdom, in close affinity with the rhizopods. Saville Kent, after prolonged investigation placed them in the animal kingdom. All these writers follow DeBary, who in 1859 first published the result of his researches, and his conclusions that they were more nearly allied to animals than plants. DeBary's conclusions were fully confirmed by Saville Kent, who traces the development as follows: Suppose the existence of a sporangium; this bursts and liberates the spores which in presence of water give birth to a globular protoplasmic body, which becomes after a time a flagellate infusorian, capable of ingesting solid food. It then loses its flagellæ and becomes an *Amœba*. Two of these conjugate and attract a number of other like bodies, or become joined to them in some way not understood. These form what is known as a plasmodium, a portion of which I exhibit under the microscope. This plasmodium is capable of apparently voluntary motion. It goes forward and retreats by a flowing motion, carrying embedded in its substance various species of algae which it has captured as food. There is a remarkable resemblance in the mode of movement between the myxomycetes and the proteomyxa. The same flowing motion of the protoplasm and the joining of the filaments to form larger ones.

The reason for the foregoing prelude is that during the month of February I have been watching one of the myxomycetes—which has developed in some water taken from the Old Town pond—into what

may be called its animal stage. In the glass jar in which it is growing it resembles a miniature tree of many branches, flattened against the glass. Before it made its appearance the glass jar was so covered with growth of algae that one could not see through it. As soon as the myxomycete made its appearance and had travelled a short distance, the glass on that part over which it passed was comparatively clear. Now that the myxomycete has gone several times round the jar, the glass is quite transparent. I took some measurements of its rate of progress.

On Feb. 26, from 2.15 p. m. to 8.45 p. m. it had travelled 1¼ inches.

Feb. 27, at 9 p. m. the distance covered was 6½ inches.

Feb. 28, a 9 p. m. 10¼ inches.

March 1, at 9 p. m. 15¼ inches.

So you will observe the rate of progress is not uniform, but the average rate of progress was 5-26ths inch per hour. A curious circumstance is that while the plant life disappears in all parts of the glass over which the myxomycete moves, it does not seem to interfere with the animal life on the glass. There are a large number of the brown *Hydra* and numerous small worms, which do not appear to be affected in any way, although they are surrounded by the plasmodium of the myxomycete.

I have not been able to definitely name the species, owing to the absence of the sporangium, but from figures I have seen it resembles *Didymium serpula*. Of course in the foregoing there is nothing very new, but having been fortunate enough to get so fine an example, so favorably located for examination, I thought it might interest some of the members to see under the microscope, an object about which so many diverse views have been held by botanists and zoologists. Apparently the only reason for the botanical claim to it is the fact that in its reproductive stage it forms sporangia like some of the fungi, while on the other hand, from its first appearance in the water or in damp places it acts precisely like an animal in its mode of progress and its way of taking in and digesting solid foods.

MISCELLANEOUS MATERIAL EXHIBITED.

Mr. L. W. Freeman presented a mastodon's tooth, obtained from Staten Island Sound by Mr. Seeley Van Pelt, while tonging for oysters. Its value was not understood by the finder, who allowed it to be thrown away with the refuse oyster shells, into Old Place Creek, from whence it was recovered by Mr. Freeman.

Boston Society of Natural History, March 7.—The following papers were read: Mr. F. P. Gulliver, The Newtonville sand plain; Mr. J. B. Woodworth, Some typical eskers of southern New England.

April 4th.—The following paper was read. Prof. F. W. Putnam: The department of ethnology at the World's Columbian Exposition.

SAMUEL HENSHAW, *Secretary.*

The Biological Society of Washington, March 10.—The following communications were read: Mr. C. H. Townsend, The Ornithology of Cocos Island in its Relation to that of the Galapagos Archipelago; Mr. B. T. Galloway, A Hexenbesen of *Rubus*: Mr. M. B. Waite, The Hexenbesens of Washington and Vicinity. Illustrated with lantern slides.

March 24.—The following communications were read: Dr. Theobald Smith, On the Significance of Variation among Species of Pathagenic Bacteria; Mr. Vernon Bailey, On some Bones from a Cave in Arizona; Mr. C. D. Walcott, On some Appendages of the Trilobite; On the Occurrence of Fossil Medusæ in the Middle Cambrian Terrane.

April 7.—The following subject was discussed. What is a Living Cell?

FREDERIC A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

Agriochœrus and Artionyx.—Mr. Hatcher has lately collected and sent to me from the White River bad lands of South Dakota a number of specimens of the genus *Agriochœrus* Leidy. This material demonstrates the fact that the genus *Artionyx* of Osborn and Wortman is a synonym of *Agriochœrus* and very probably, that the specimens which I described under the name of ? *Mesonyx dakotensis* from the same horizon, should be referred to the same or to some closely allied animal. A description of this extraordinary type will very soon be published. W. B. Scott.

The Haeckel Celebration.—On the 16th of February, Ernst Haeckel completed the sixtieth year of his life. On the 17th, the little town of Jena, in whose University Haeckel is Professor of Zoology, was thronged by a great crowd of his friends, pupils and admirers, among whom may be specially mentioned the Hertwigs (Oscar and Richard), Waldeyer, Arnold Lang and Hermann Credner, besides many well known professors of Jena itself. The chief ceremony of the day was the uncovering of the marble bust of the great scientific worker and writer, from the chisel of the eminent sulptor, Professor Kopf of Rome. At noon the lecture-theatre of the Zoological Institute, in which the greater part of Haeckel's life work has been carried on, was crammed from floor to ceiling, and Professor R. Hertwig, of Munich, the pupil, friend and colleague of Haeckel, was called upon to unveil the bust. In an admirably-worded speech be alluded to the main facts of Haeckel's life, and especially to his labors in the cause of science and scientific freedom. The unveiling of the striking bust was the signal of a great outburst of applause, and when this had subsided, a deputation from some societies, the Medicinishe-naturwissenschaftliche Gesellschaft of Jena and the Geographische Gesellschaft of Thüringen, offered to Professor Haeckel their honorary membership. They were followed by a deputation from the students, who expressed in enthusiastic terms their admiration and respect for the Professor of Zoology. Professor Max Fürbringer of Jena followed with details concerning the subscription to the bust, informing us that there had been nearly 700 subscribers, who sent their tokens of appreciation from all parts of the world; he especially alluded to the gratifying fact that many subscriptions had come from France. As a consequence of this, the total

amount exceeded the cost of the bust by at least £300, and this sum he had pleasure in placing in the hands of Professor Haeckel, for him to devote to such purpose as he might think best in the interests of science.

After the ceremony, and after Professor Haeckel had, not without emotion, acknowledged the honors showered upon him, the elect among the visitors adjourned to a banquet in the Hotel Zum Bären, where covers were laid for about 120 of both sexes. The day concluded with the characteristic German institution, a "Commers," in which almost all the students in Jena seemed to be taking part. Cheers for the Professor, songs and speeches in his honor, mingled with the clinking of glasses, enlivened the old university till a late hour at night.—*Natural Science*, March.

Mr. Henry O. Forbes, well known for his interesting account of his travels through the Eastern Archipelago, has been appointed Curator of the Liverpool Museum.

Dr. J. Boehm, the botanist, of Vienna, is dead at the age of 62.

Richard Spruce, the botanist, died at Coneysthorpe, England, Dec. 29, 1893, at the age of 76. He traveled extensively in his younger years and accumulated one of the most valuable herbaria in England; he also published numerous botanical papers, but he will longest be known from his successful efforts in introducing the Cinchona plants into India.

Dr. Friedrich Zschokke has been made ordinary professor of zoology in the University of Basel, in the place of Prof. Dr. L. Rütimeyer retired.

Dr. J. Vosseler, formerly of Tübiugen is privat-docent of Zoology in the technical high school of Stuttgart.

Dr. W. Migula, formerly docent, has been made Professor of Botany and Bacteriology in the technical high school at Karlsruhe.

Dr. Saposchnikoff has become Professor of Botany at the University of Tomsk, Siberia.

Mr. R. T. Günther is to be science tutor in the Magdalen College, Oxford.

The library of the late Prof. A. Milnes Marshall has been given to Owens College, Manchester, by his friends and executors.

The Sixth Geological Congress will meet in Zürich from August 20 to September 2, 1894.

Dr. Justus Karl Hasskarl, the botanist, who introduced the cultivation of Cinchona into Java, died at Cher, Prussia, Jan. 5, 1894.

Edmond Frémy, Director of the Museum of Natural History at Paris, is dead.

Alexander Theodor von Middendorf, the Arctic explorer, died Jan. 28, 1894. He was born in St. Petersburg in 1815.

Dr. K. Zelinka of Graz has been appointed extraordinary professor of zoology in the University of Vienna.

The list of literature in the current volume of the "Zoologischer Anzeiger" has been greatly improved, not only by being brought out more promptly than heretofore but by the addition of abstracts of a few lines stating the substance of the article. It may be that editors and publishers were spurred up to this by the announcement of the "Zoologisches Centralblatt," the first number of which bears date Feby. 1, 1894. This new publication is designed to furnish abstracts of the principal articles at the earliest possible moment. It is edited by Dr. A. Schuberg of Karlsruhe, with the assistance of Professors Bütschli of Heidelberg and Hatschek of Prag. The first number, containing 40 pages, is not remarkably strong.

The San Francisco Microscopical Society extends a cordial invitation to those interested in microscopy to visit its rooms, 432 Montgomery St., San Francisco, Cal., and to attend its meetings the first and third Wednesday of each month. The officers for 1894–95 are Prof. W. E. Ritter, president; W. E. Loy, vice-president; F. E. Crofts, recording secretary; G. O. Mitchell, corresponding secretary; C. C. Riedy, treasurer.

The following is the list of officers of the Zoological Society of Philadelphia: President, Charles Platt; Vice-president, J. Vaughn Merrick; Corresponding Secretary, Prof. H. C. Chapman; Treasurer, William Hacker; Directors, W. H. Merrick, I. J. Wistar, C. W. Trotter, F. S. Fassitt, G. C. Morris, F. W. Lewis, M. D., C. M. Lea,

C. C. Febinger, D. S. Sellers, S. G. Dixon, M. D., J. B. Henry, J. B. Leonard.

Hon. Walter Rothschild proposes to publish a periodical in connection with his museum at Tring, under the title of "Novitates Zoologicæ." It will contain papers on mammals, birds, etc., and also discussions on questions of zoological or paleontological interest. Descriptions of new species will be confined almost entirely to those of which the types belong to the Tring Museum, and the other articles will, for the most part, be founded on work carried on at that museum or on specimens sent by Mr. Rothschild's collectors.

From the March number of *Forest and Stream* we learn that the buffalo in Yellowstone Park are again being harassed by hunters. A year ago this winter several buffalo were killed; last spring and the spring before, a number of calves were captured; this winter ten buffalo have been slaughtered at a single killing. At this rate it will not be long before the last shall have been shot down. It is for the people to say whether or not they desire this.

Dr. Robert Lamborn has presented a valuable library of archeology to the University of Pennsylvania.

The Zoological Garden of Philadelphia purchased the orang-outang which was on exhibition in the Javanese Village at Chicago. It is a very intelligent and cheerful animal. Subsequently it acquired a pair of Cheetahs, and the rare *Felis egra* and *F. jaguarondi* from Mexico.

Extracts from examination papers: "The meganucleus breaks up, the micronucleus breaks down." "I don't quite understand the difference between Bacterier and posterior."

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THE MEANING OF TREE-LIFE.

BY HENRY L. CLARKE.[1]

Few there are, even among thoughtful botanists, who seem to clearly realize how broad a lesson on the life-history of plants is written in the trees that make the great forest regions of the world. Whether we stand among the palms of the tropics, or the pines of the north, or the congeners of the poplar and oak, we feel instinctively that there is an impressive depth of meaning in the very aspect of a tree. And it is no deception of the fancy. Tree-life represents the culmination in the work of one of the two great factors, reproductive energy and vegetative energy, that together shape the course of plant-development. The history of plants records a constant two-fold struggle; on the one hand the effort of plant-life as a whole to perpetuate itself by improving its methods of reproduction; on the other, the stand for self-preservation made by each distinct individual or species or group,—a stand that can be taken only through sheer force of vegetative luxuriance. But these two phases of the struggle for existence have by no means been independent of each other: they have acted together in varying ratio in the making of every type, though their respective influences have culminated in widely separated forms. As the highest outcome of evolutionary progress in the character of floral organs we point to

[1]University of Chicago.

the orchids, among Monocotyls, and the kinsmen of the golden-rods and asters, among Dicotyls ; as the monarchs of vegetative energy stand the tree-ferns and towering palms of the tropics, the Red-Woods of California, the Eucalyptus of Australia, and our forests of mighty oak. Thus the classification systems of modern botany that review in the clearest scientific light the evolutionary relationships of species, genera, orders, and classes, present to us only one side of the problem of plant-life; the dynamics of vegetation is the other. We may know that the Coniferae are among the most primitive of flowering plants, and the Orchidaceæ and Compositæ among the highest; but why do we find our orchids and composites growing as stunted herbs in the very shadow of conifers that are giant trees? Which is master of the situation? Systematic botany has not fulfilled its mission until it has grasped both sides of the two-fold relation that the contrasting types bear to one another.

Far back in geologic time the dawn of tree-life came almost with the beginnings of vegetation. What the earliest of those beginnings were we can scarcely even conjecture, but going back as far as fossil botany will carry us with certainty, we may conceive something of the conditions under which the primitive plant-world was fostered. Consider the probable conditions of the Cambrian and Silurian Ages. However, scant the records that we hold, they are yet sufficient to give us some suggestions of inestimable importance. Past question the earliest forms of plant-life were denizens of the water, developed in the seas and lakes of Pre-Cambrian times. From their aquatic habitats they must have first gradually emerged, as the cooling of the primordial continents permitted, and the strengthening of their own anatomical characters favored, into the swamps and marshes, and then step by step mounted the higher regions of the dry land. The oldest fossil types we with certainty know of were far from the beginning of the scale; they could only have been products of ages of development that must forever remain to us almost a total blank. The world of Silurian times was probably a torrid zone from pole to pole, a condition traceable in large part to the insular

character of its continents. The surcharging of the atmosphere with water-vapor meant excessive precipitation, and the shallow-water conditions obtaining around the continental islands, together with the probable lowness of these isolated landmasses favored the existence of extensive swamps and marshy flats, in which the water may have been either fresh or brackish. Here in these primordial swamps the vegetation destined to cover the earth made its determined struggle for existence. On the higher land there was too much heat; in the seas there was too much water; in the swamps was the requisite combination of water, heat, and heavy carbon-laden air. Under such conditions the first types that took possession must have spread and multiplied with incredible rapidity. What followed? Inevitably the primitive low-growing plants crowded closer and closer together and became a rank tangle of growth; where there had been at first plenty of room for every individual to spread, there were now many struggling for the mastery of each square foot of swamp. All had a foothold in the earth but only the few that stood the highest could drink in the feeble rays of the cloud-bedimmed Silurian sunshine. Then the real battle for the light began in earnest, the stronger against the weaker, the older established types against the newer ones whose foot-hold was less certain; higher and higher the rank swamp-growth rose, all its members struggling together for the light and open air. And so in the wierd gigantic club-mosses of those far-off times we see the prophetic beginnings of the tree-life of to-day; and to trace the development of the majestic forests of the present from those dank swampy jungles of the past is the problem before us. It would seem at first glance that in the primæval jungle "might made right," if ever it made it anywhere. But no! the "survival of the fittest" worked in two directions. Vegetative luxuriance was a tremendous factor in determining the survival of types, vastly more so then than now; but wherever an improvement in the character of reproductive organs increased the certainty with which any plant could perpetuate its race, that gain could often far outweigh the superior vegetative luxuriance of all competitors. This second factor in the "survival of the fittest"

has been steadily waxing in importance from primæval times, while the other has begun to wane. In the midst of the Silurian jungle, where the energy of plant-life was strained to the utmost limit of activity, new forms originated. What was their fate? They could not overpower the strongly established older forms crowding all about them, so either they must perish or push outward toward the open margin, where there was room to fight. Thus the swamp-margin became the tension-line between the uninhabitable higher land and the old strong hold of the jungle, and on this tension-line stood the vanguard of the world's future vegetation. On its outer edge the tension-flora faced a new and untried habitat, and then, as now, a highly specialized habitat meant highly specialized inhabitants. The untried ground could not be conquered by sheer force of vegetative luxuriance, for by their very nature the new conditions were physically opposed to the established order of things in plant-life. The all-powerful factor in accomplishing the conquest was increased capacity for variation and the adaptive evolution of old structural types into higher stages of organization. Clearly, this tendency predominated and pervaded the whole tension-line flora, but its maximum was toward the outer edge. So here were ranked the low-growing herbaceous forerunners of coming ages,—forms that were humble in their growth, because of the physical obstacles opposing them; and highly specialized, because their structure did not possess the obstinate stability of the patriarchal tree-life behind them. For the same reasons the character of the undergrowth in the jungle must have always been ages in advance of the arboreal monarchs towering overhead. But on the inner side of the tension-line, vegetative luxuriance was not only possible and potent but also obviously a necessity, for there could be no abrupt demarkation between the marginal and central regions. Here, then, where the jungle-flora merged into the tension-flora, was the stronghold of the rising generations, the newer higher types, of tree-life. Here, in early Silurian times, must have stood the ancestral types of the great tree-ferns and calamites and conifers that were to be supreme in the Carboniferous and early Mesozoic.

The history of plant-life through the later Silurian and the Devonian Age records the first strong establishment of a truly dry-land flora, a substantial foreshadowing of the Mesozoic. The changes in physical conditions of course furthered this result no less truly than did the adaptive evolution of organic forms. In the dry-land forests of the Devonian rose the vegetation whose future developments should hold dominion when the primordial swamps had disappeared from the earth. But these terrestrial forests evidently had the effect of removing an immense part of the pressure upon the old swamp-jungles by becoming the main refuge and stronghold of the new types crowded out at the old tension-line. This, together with the physical changes recorded in the rock-systems of the times, gave full vent to the gathering vegetative energy that reached such a stupendous culmination in the mammoth swamp-flora of the Coal Age. Here was a turning point in plant-history. With the dawn of the Mesozoic came the clear prophecy of modern conditions. The dry-land forests of the Reptilian Age were the full realization of the conditions foreshadowed in the Devonian. Out of the swamp-forests of the Carboniferous came some of the highest Lycopods, great Tree-Ferns, and giant Equisetums. Down from the Devonian came the Conifers of the yew-family; and as reminders of the old genus Cordaites the new order Cycadaceæ appeared. Undoubtedly it is impossible to believe that the swamp-flora of the coal seams represents anything like the whole flora of the Carboniferous Age. There must of necessity have also existed then a great transitional dry-land flora between the terrestrial forests of the preceeding Devonian and the succeeding Jura-Trias. Much of the strata called Devonian or Mesozoic probably represents this transition and was synchronous in its formation with the accumulation of the coal. Part of the transition is clearly observable in the noncarboniferous formations included between the coal-seams. While the prep-arations, begun in the Devonian, for the great Mesozoic forests were slowly and surely progressing, the old vegetation of the swamp-jungle swept up to its culmination, and marked by its decline the close of the Paleozoic Era. The early Mesozoic

became the age of Gymnosperms. Vegetation had come upon a new battle-field, the terrestrial forest-ground, and only the most highly organized types of preceeding ages were fitted to enter the struggle. Many of the Tree-Ferns and Equisetums were still powerful, but the supreme dominion passed over to the Conifers and their allies, the Cycads. The great forests of Conifers had their undergrowth and their tension-lines, and here the development of new types was progressing with probably even greater activity than in the tension-floras of earlier times. The greater complexity of the conditions confronting a terrestrial flora over those confronting a swamp flora would necessarily mean more elaborate specialization. While the ancient coniferous tree-forms were mounting to the fulness of their power the first types of the higher flowering-plants were beginning to appear; and with the opening of the later Mesozoic, the Cretaceous, two new groups of tree-life came upon the stage as worthy competitors of the old established Gymnosperms. One was the order Palmaceæ, representing the Monocotyledonous Angiosperms; the other was the amentaceous hardwood tree-families, representing the Dicotyledons. The opening chapter in the history of these two groups is a matter of peculiar interest.

It is probable that the two groups were almost, if not quite, synchronous in their rise; though there is some reason to believe that the Palmaceæ, or at least their forerunners, the Pandanaceæ, are slightly the older. As has been indicated the central strength of the Mesozoic forests was undoubtedly held by the coniferous trees; and probably by far the greatest strength was vested in the near allies of the Cypresses, Pines, and Firs,—representing the tribes Cupressineæ, Taxodieae, Abietineæ, and possibly also Araucarieæ,—while the older sub-order Taxineæ, the broad-leaved Conifers of the Yew family, were rather crowded out toward the tension-line margins along with the Cycads and Tree-Ferns. Among these last the first low-growing Tree-Palms probably rose, as the products of a long course of elaborate specialization. It is more than possible that the Pandanaceæ represent at least in part a transitional stage between some of the higher Gymnosperms and the

Palmaceæ; and it is well worthy of note that the aerial roots of the Screw-Pines, the Pandanaceæ, are a living memorial to the position they originally held on the shore-margin of a forest tension-line. The habit of growth of the Palmaceæ most strikingly suggests that their first competitors were Tree-Ferns and Cycads, even as they are in many regions to-day. It seems as if the first Palms had met the Mesozoic Tree-Ferns and Cycads on their own ground,—the forest margin,—with their own weapons—the tall aspiring trunk topped with a crown of leaves. And by their general higher character of organization the Palms ultimately asserted their preeminent superiority. The wide constrast between the floral characters of the Palmaceæ and those of the Gymnosperms presents a difficult problem. There is a strong likelihood, however, that the spadiceous inflorescence of the Screw-Pines and Palms is a highly specialized development from the cones of some aberrant Cycad or Conifer. At least all the probablities indicate that the spadiceous Monocotyls approach much nearer the Gymnosperms than do any of the non-spadiceous ones. All this has evidently a most significant bearing on the question before us, of the Palms' place in Nature. We have seen that the vegetative character of the Palms was widely different from that of the dominant Conifers; and now we note that their floral organs were also widely different, and in fact far more decidedly unlike the cones of the Cypresses and Pines than are the "catkins" of the hardwood dicotyl trees.

There are a half-dozen or more tree-orders among the Dicotyls that should really stand apart as forming a small subclass quite decidedly distinct from the rest of the Dicotyls. As the principal orders of this group may be named the Juglandaceæ, Myricaceæ, Salicaceæ, Betulaceæ, Fagaceæ, Ulmaceæ, Platanaceæ, and a couple of others. These have been called the Amentaceæ, or the Diclinæ, and might be regarded as a subclass. Except in the approach of Ulmaceæ to the Urticaceæ, the Diclinæ stand clearly apart as a distinctive highly specialized alliance of trees and shrubs. Their relation to the Mesozoic Gymnosperms is an interesting question. In general habit of growth and in the character of their wood they evidently make a close approach to the Conferæ.

The amentaceous inflorescence predominating in the group bears a decided likeness to the cones of the Pines and Cypresses. Obviously then, the Diclinæ were the trees best fitted to battle with the central stronghold of the Mesozoic coniferous forest, and probably they were first fully developed on the inner portion of the tension-line, face to face with the strongest of the Conifers. Behind them, toward the outer edge stood the Tree-Ferns, Cycads, and Palms; but which, we may ask, were the Conifers that stood closest round about, among and before them? Probably the sub-order Taxineæ, the fraternity of broad-leaved Taxites and Gingkos. The power of this most ancient group of Conifers had, as we have seen, waned, and they must have been driven toward the outskirts of the forest by the stronger Cupressineæ and Abietineæ. Here they must have met the early Diclinæ. Where did the Diclinæ develop the broad flattened leaf-blades that so strikingly distinguish their foliage from that of our living Coniferæ? Where, if not in a competitive struggle with the broad-leaved Taxineæ of the Mesozoic forest-margin? The ancient Taxineæ had reproduced in their foliage something of the character of the fern-fronds; the newer Pinaceæ had rather imitated and exaggerated the scale-leaves of the great Carboniferous Lycopods. And finally, the broad leaves of the Taxineæ were perpetuated, under greatly improved and elaborated forms, in the Diclinæ. Through the Cretaceous the Coniferæ rose to the zenith of their power; the Tree-Ferns and Cycads weakened; the Palmaceæ and Diclinæ, more particularly the latter, fast gathered strength toward the dominion they claimed in the succeeding Tertiary. Meantime, in the undergrowth and on the open margins of the forests, and on the open country that did not support a growth of trees, the evolution of the higher types of Monocotyls and Dicotyls was rapidly progressing. Many of the stronger forms became shrubs, and here and there a peculiarly favored type rose from lowly herbaceous to arborescent habit, and thus founded a new tree-group. Such, for instance, were the Magnolias and Tulip-Trees and Maples and many others. In all this we read an increasing complexity in the conditions presented to onward struggling plant-life, and here a vitally important point rises for our consideration.

(*To be continued.*)

THE SCOPE OF MODERN PHYSIOLOGY.

By Frederic S. Lee.

(*Continued from page 388.*)

Three achievements of the present period have shown investigators how broad their science really is. First, the establishing of protoplasm as the physical basis of life, and of its substantial identity in plants and animals by Dujardin, Von Mohl, and Max Schultze, showed that the really fundamental problems of life and action had heretofore not been grasped; that the essential laws of protoplasmic activity apply to the whole organic world; and hence that any physiology which confines itself rigidly to either plants or animals to the exclusion of the other is a one-sided science. Second, the cell-theory of Schleiden and Schwann demonstrated that sooner or later many functions must be traced back to the cell, and that a cellular physiology is the key to a large proportion of the problems arising in the biological world. Third, the work of Darwin, based, as it was, upon physiological principles, showed that the action of the environment upon the individual and upon the species, as well as the action of the organism upon the environment, was an almost unworked field of the richest promise: that all physiology, in order to be complete, must be comparative; that there is an ontogenetic and a phylogenetic evolution of function; and that the physiological laws of heredity were yet to be discovered.

Let us examine these ideas briefly. The necessity of understanding the physiology of undifferentiated protoplasm is obvious, for there we find function in its simplest and most generic form. The phenomena of projection and retraction of pseudopodia in the Amoeba are doubtless the key to the complex processes of contraction and relaxation of striped muscular tissue. It is not at all improbable that the action of light upon the retina is a specialized derivative of the heliotropic phenomena of the simplest plants and animals. Four years

ago, the well-known Oxford physiologist, Burdon Sanderson, wrote concerning the nature of the physiological inquiry, "The work of investigating the special functions, which, during the last two decades, has yielded such splendid results, is still proceeding, and every year new ground is being broken and new and fruitful lines of experimental inquiry are being opened up; but the further the physiologist advances in this work of analysis and differentiation, the more frequently does he find his attention arrested by deeper questions relating to the essential endowments of living matter, of which even the most highly differentiated functions of the animal or the plant organism are the outcome." Again, "No one who is awake to tendencies of thought and work in physiology, can fail to have observed that the best minds are directed with more concentration than ever before to those questions which relate to the elementary endowments of living matter, and that if they are still held in the background, it is rather because of the extreme difficulty of approaching them than from any want of appreciation of their importance. * * * * If we really understood them, they would furnish a key, not only to the phenomena of nutrition and growth, but even to those of reproduction and development. * * * * It is in the direction of elementary physiology, which means nothing more than the study of the endowments of living material, that the advance of the next twenty years will be made."

Regarding the need of a cellular physiology, it is only necessary to review our knowledge of any one of the complicated organs to perceive that aside from the principles, often chiefly mechanical, involved in the work of the organ as a whole, the essence of its activity lies in the activity of its component cells. The work of the muscle, *e. g.*, is the sum of the activities of its constituent physiologically similar fibres. A single gland cell illustrates the principles of secretion as well as, or even better than, a thousand grouped together into a compact gland. The complexity of brain operations is due to the complexity of brain structure, but the active agents are the comparatively simple nerve-cells. Huxley sets forth as the first three of the five chief ends of modern physiology: "Firstly, the ascertain-

ment of the facts and conditions of cell-life in general. Secondly, in composite organisms, the analysis of the functions of organs into those of the cells of which they are composed. Thirdly, the explication of the processes by which this local cell-life is directly, or indirectly, controlled and brought into relation with the life of the rest of the cells which compose the organism." Now that the structure of protoplasm is fast becoming disentangled, a rational cell-physiology will be possible. In urging the need of investigating cell-function, I do not mean to imply that the cell is necessarily the ultimate unit, and that the organism is to be regarded as substantially a colony of physiologically independent cells. Much of the recent cytological work indicates that ere long the cell may be deposed from its hierarchical position.[1] Cellular interactions are to form an increasingly prominent place in the researches of cell-physiologists. But, whether or not we grant with many that the cell is of secondary significance, we must allow that, in many respects at least, it may be regarded as a physiological unit; and from this standpoint it demands investigation.

In these days of comparative science, it seems superfluous to urge the necessity of a comparative physiology. No one, who thinks seriously of the matter, will doubt that along with the morphological distinctions between different species, genera, orders, or classes, and even in cases where gross morphological distinctions are not apparent, there must be physiological differences. Beyond the obvious facts of simple observation, these are almost wholly uninvestigated. De Varigny, in his suggestive little book on Experimental Evolution, has collected a number of the known facts. In a garden in the south of France, were growing, side by side, a number of plants of the same species. There appeared to be no morphological differences between them, but some were indigenous to the soil in which they were growing, while others had been imported from the Canary Islands. When they were attacked by frost, all the Canary Island forms perished, while the French forms were untouched. There was evidently some obscure physiological difference between them. The two common European species

[1] Cf. Whitman, *Journal of Morphology*, VIII, No 3, August, 1893.

of frogs, *Rana temporaria* and *Rana esculenta*, behave very differently toward certain drugs, as Schmiedeberg, Monnier, Vulpian, Harnack and Meyer, and others have shown. In *R. temporaria*, caffeine causes a decrease in excitability; in *R. esculenta* an increase; in *R. temporaria* pilocarpine causes paralysis; in *R. esculenta* tetanus. The venom of one snake is harmless for its own species, but poisonous for others. The spinal cord of the fish is differently endowed from that of the frog, though the differences have never been properly investigated. The muscle of the Insect is far removed functionally from that of the Crustacean, though how far remains to be discovered. I do not overlook the fact that already much excellent work upon the physiology of the Invertebrates and lower Vertebrates has been done, but too often such work has not been *comparative*. Fitness for the object of the research is the usual determinant of choice—and hence the frog has taught us most of our physiology of muscle. Sooner or later this must all be changed, the functional differences must be made known, and the exact position of each plant, each Invertebrate, and each Vertebrate, in the physiological series, together with the exact position of his organs and tissues and cells must be understood. For we must recognize the fact that function in any one species has *come to be*—an evolution of function is as much a reality as an evolution of form. The adult body and its organs, tissues and cells are the functional derivatives of the germ-cells—in the growth of the individual there has been a physiological ontogeny. So in the growth of the species there has been a progressive or retrogressive development of function; and one of the most attractive fields for our future work will be the tracing out of the phylogeny of function, now a practically unknown subject.[2] The difficulty of such an undertaking is great, for the rich palaeontological series is beyond the reach of the experimentalist. Yet this should be no bar to the systematic investigation of existing forms. Such a phylogeny will vary with each functional part (organ, tissue or cell); *e. g.*, if, in one genus, certain brain functions and certain secretory functions are always found, the presence of the same brain

[2] Cf. Dohrn, *Das Princip des Functionswechsel.*

functions in another genus does not necessarily indicate the presence of the same secretory functions. Nor will the line of functional descent of a part necessarily coincide with the line of morphological descent of the organism. A natural system of classification is based and, justly so, on morphological considerations. In thus tracing out the genetic relationships of function, lie the attractiveness and the utility of the comparative method in physiology. And I venture to assert that, if all investigators would bear in mind the fact of an evolution of function, surprising advances would result in our knowledge of the working of adult organs.

What is it that makes an individual physiologically what he is? There are two agents—heredity and the environment. As to heredity, the active discussion now going on around Weismann as a centre, serves to show what a vast amount we do not know, on both the morphological and the physiological sides as regards the general phenomena of heredity and the nature and behaviour of the hereditary substance. No one recognizes this more fully than Weismann himself. He confesses that his own theory is far from complete; that its importance consists primarily in its suggestiveness: that the real solution of the problem lies in the future, and that facts are greatly needed. In this connection I may refer to the value of the work of Nussbaum, Gruber, Balbiani, Hofer, Korschelt, Verworn and others on the physiological relations of the nucleus and cytoplasm.

The mutual relations of the environment and the individual are almost as unknown as when Darwin first demonstrated their importance. In a few special lines they have been investigated. In his earthworm studies Darwin himself set an eminent example. The fact of the modification of the virulence of pathogenic bacteria by their treatment during growth is well known. Interesting results have been obtained regarding the action of salt-water on fresh-water animals, and *vice versa*; the action of salts on starch production in plants; the effect of depriving animals of apparently important salts, *e. g.*, fowls of carbonate of lime, and crabs of calcium chloride. Maupas's well-known studies on the influence of temperature on

the determination of sex may be mentioned here, as well as those of Yung, Mrs. Treat, and others on the influence of foods. If an altered environment is capable of altering function—and we know this to be a fact—and if the altered function reacts upon structure—which is equally undoubted—then we find in these premises sufficient justification for searching after the facts concerning the nature and extent of environmental influence. The value of such researches lies not so much in the isolated results themselves, as in the fact that such results, when sufficiently numerous, will lead us directly not only to a better understanding of the internal physiology of organisms, but, what is of more general interest, to an understanding of the causes of variation, and thus to a better comprehension of the relations of species to one another. Too much cannot be said upon this phase of our subject. Whether the direct action of the environment is to be considered as a factor in organic evolution or not, the causes of variation must be investigated *experimentally*, and the physiological side of the work must not be neglected. Semper says, "Although the morphological section of animal biology[3] teaches with much probability that this species or that organ has undergone this or that course of modification in the animal series, and that in the process of modification it has passed through a whole series of various forms, still it is only physiological research that can elucidate the necessity for their existence by revealing their causative conditions."

One word regarding the relations of physiology and morphology. In the broad way in which I have outlined the former science, it may be charged that I have trespassed upon the morphological preserve. I do not deny the charge. It seems to me altogether unnecessary, undesirable and moreover impossible to draw a sharp line of distinction between the two sciences. With a common origin, mutual independence was, in time, necessary to the growth of each, yet this is in entire harmony with the fact that they have a common meeting-ground. In these days, as always, the morphologist must be something of a physiologist; the physiologist something of a

[3]He might justly have omitted the word "animal."

morphologist. The current researches and discussions on evolution, heredity, and other fundamental questions make this constantly more evident. Like zoology and botany, each has its special field of labor, its special methods, and its special problems; but the fields are constantly overlapping, the one learns methods from the other, and the ultimate problems of both are the same.

Let us now draw together the main lines of our thesis. I prefer to conceive of physiology as the science of the dynamics of living matter. Its tasks for the future seem to comprise the following classes of investigations.

First, the functions of adult organs, tissues and cells in plants, Invertebrates and Vertebrates. The greatest interest at present appears to center about the phenomena of heredity, the central nervous system, and general cell physiology. Second, the ontogeny of functions, or embryological physiology. Third, the phylogeny of functions. Fourth, the physiology of organisms, comprising the mutual relations of organisms to each other and to their environment.

It would be superfluous here to discriminate between the opportunities for research offered in these four classes of problems. Each covers a wide field of rich promise. Each is largely worked—in reality, as we have shown, research in the past has been confined almost wholly to the first group. Each will lead the investigator to fundamental problems.

In considering these tasks it will be perceived that I have viewed the organism in two aspects, in its internal and its external relations. The problems of the first three groups may be regarded as belonging to *internal physiology*, those of the fourth to *external physiology*. Nearly twenty-five years ago, Haeckel made a similar division into *Conservations-* and *Relations-Physiologie*.[4] Such a classification is convenient and valuable. But it must be remembered that it is artificial, and must not be taken as indicating a fundamental distinction between two sciences. The two are departments of the one science, physiology, and pass the one into the other. For a fact that becomes the more striking, the longer one studies the

[4] *Jenaische Zeitschrift*, V, 1870.

dynamics of living matter, is the utter impossibility of drawing a sharp line between the internal and the external. The functional organism is constantly acted upon by the environment, and is incapable of existence apart from it. But the functional organism is but the *ensemble* of the functional parts, and the parts are linked functionally together, constantly acting and reacting upon each other and modifying each other's work. It follows that the innermost portions cannot free themselves from environmental influence, and the attempt at an essential separation of internal from external physiology is in vain. Nor is such an attempt justified any the more by methods of investigation. For he who studies the action of light upon the retina, is thereby fitted to investigate the heliotropic phenomena of the organism; and he who is familiar with methods by which the effect of salts or temperature on the organs is tested, is most capable of testing the influence of the composition and the temperature of the surrounding water upon aquatic animals and plants. I speak of this the more especially because of the fact that, since the completion of the greater portion of this paper, the able address of Professor Burdon Sanderson, as President of the British Association for the Advancement of Science, has appeared.[5] In an interesting manner Professor Sanderson reviews the aspects of physiology since the time of Müller. He says, "The distinction * * * * between the internal and external relations of plants and animals has, of course, always existed, but has only lately come into such prominence that it divides biologists more or less completely into two camps—on the one hand, those who make it their aim to investigate the actions of the organism and its parts by the accepted methods of physics and chemistry, carrying this investigation as far as the conditions under which each process manifests itself will permit: on the other, those who interest themselves rather in considering the place which each organism occupies, and the part which it plays in the economy of nature. It is apparent that the two lines of inquiry, although they equally relate to what the organism *does*, rather than to what it *is*, and therefore both have

[5] *Nature*, September 14, 1893.

equal right to be included in the one great science of life, or biology, yet lead in directions which are scarcely even parallel." Giving then a somewhat misleading interpretation of Haeckel's ideas above referred to, Professor Sanderson proceeds to divide Biology into three parts, Morphology, Physiology, which deals with the "internal relations of the organism," and Oecology (a term borrowed from Haeckel) "which concerns itself with the external relations of plants and animals to each other, and to the past and present conditions of their existence." In another place, Professor Sanderson says, "No seriously-minded person, however, doubts that organized nature, as it now presents itself to us, has become what it is by a process of gradual perfecting or advancement, brought about by the elimination of those organisms, which failed to obey the fundamental principle of adaptation, which Treviranus indicated. Each step, therefore, in this evolution, is a reaction to external influences, the motive of which is essentially the same as that by which, from moment to moment, the organism governs itself."

I realize how presumptous it appears in me to differ from or attempt to criticise the views of one who occupies so deserved a place among the foremost physiologists of to-day. Yet I cannot repress the thought that the author of the Nottingham address viewed his subject more in the waning light of a day that is ending than in the brightening beams of a coming dawn. If each "step * * * * in this evolution is a reaction to external influences," why should not the student of the "steps" study also the origin and causation of those steps? I think he would justly be open to the charge of narrowness if he did not do it. And, moreover, as I have indicated above, I believe not only that he of all is best fitted, but that a rational view of his science forces him to do it. The progress of a scientific physiology has been greatly retarded by its followers confining themselves too exclusively to "the internal relations of the organism." Not the least of the retarding consequences is the fact that thereby the science loses much of its attractiveness. Just as anatomy, illumined and vivified by the theory of evolution, and broadened by the incorporation of embryol-

ogy and paleontology, became the science of morphology, so I believe that physiology is destined to undergo, and is undergoing, a similar vivifying and broadening process, and is to become the science of vital phenomena, wherever and however they may be exhibited.

UNUSUAL FLIGHTS OF THE GROUSE LOCUST (TETTIGIDEA LATERALIS SAY,) IN NORTH EASTERN ILLINOIS.

BY JOSEPH L. HANCOCK.

At certain times, seemingly without premonitory indications, some insects suddenly change their habitat; although closely allied forms inhabiting the same locality under similar general influences, show no disposition to do so. That there are predisposing conditions which are the ruling causes of these specific migrations is plainly evinced by careful study. Before confining our remarks to a single species *Tettigidea lateralis* Say, "The Grouse Locust" as an illustration in point, a sketchy recapitulation of the phenomena of migration in the family Acrididæ, of which the above is a member, may be given to some advantage. The various forms of grasshoppers, constituting this large family, are not as a rule migratory; as a matter of fact, somewhere near a dozen only are given to making sudden sweeping changes, by flight over a large territory foreign to their hatching grounds. In two species, whose anatomical differences are but very slight, one may be truly migratory while the other is not, as seen for example, in *Melanoplus spretus* and *Melanoplus femurrubrum.* The confusion arising from an indefinite interpretation of migration in its truest sense, as distinguished from the shorter "local flights" as appled to insects, is often perplexing. Let us attempt to set at rest, as far as possible, such misconception of terms.

Individuals of a species which effect a more or less regular periodical change in their habitat, are truly migratory. Migrations may be primary, consisting of local flights; such as movements by insects hatched in temporary regions to which they confine themselves to passing to and fro, from point to point, or secondary, as the repeated periodical changes of residence covering foreign fields, which virtually establishes a nomadic habit. We have hinted that there are predetermining

conditions effecting these movements, principal among them being a break in the interrelation of food supply, or improper conditions for the carrying on of propagation. The unusual appearance of insects in a given locality, classed under the category of primary or "local flights," are met with occasionally by observers. One of considerable moment is set forth in the following narration: On the nineteenth of September, 1893, the Grouse Locust, with a few other members of Acrididæ, striking out for more favorable conditions, landed at night in swarms in Chicago. The writer noticed them everywhere in the city. The small size of this locust (♀, ♂—12–16 mm.) in length, with peculiar inconspicuous colors, caused them to be overlooked by the people passing the next day who, without being conscious of the fact, crushed thousands under their feet, leaving tiny stains upon the sidewalks. Again, two days following their first appearance, on the twenty-first inst., multitudes of Grouse Locusts dropped during the night. As individuals, they were comparatively large and vigorous. Many were taken to indicate the range of flights; specimens being recorded at scattered points. A region covering, not only the City of Chicago, but the northeastern portion of Illinois and that part of Indiana including the lower bend of Lake Michigan adjacent, as shown in the accompanying map Fig. 4, was represented. Observations in the city showed that the electric arc lights, to which they were attracted, killed off large numbers, while the stretch of waters in the lake destroyed others.

Through the streets, in the heart of the city, the writer collected in a short time, twenty-seven specimens, comprising thirteen males and fourteen females, showing a remarkably even distribution of sexes. A significant point indicating the direction from which they came was gathered from the fact that most, if not all the specimens, when examined, on the streets running east and west, were on the north side of the street, showing that they were blown against the tall buildings and then dropped to the ground. Information received from Mr. H. C. Frankenfield, local forecast official, who kindly favored the writer with a report, giving the direction of the wind

at the time of the flights, is appended below. It is interesting to note that the preconceived idea of their course was confirmed. His report indicated that the wind during the twenty four hours which brought in the Grouse Locusts on the night of the nineteenth inst. blew from:

Southeast	2 Hours.
South	3 Hours.
Southwest	19 Hours.
Total	24 Hours.

The general direction pointing from the southwest. In the second flight the wind blew from:

East	1 Hour.
Southeast	18 Hours.
South	4 Hours.
Southwest	1 Hour.
Total	24 Hours.

Showing a mainly southeastern wind.

Nothwithstanding a residence of many years in this locality, no other instance of unusual migration of this particular species has been observed, except during the preceding fall, 1893, which was characterized also by flights in very small numbers, marking the first instance of their occurrence here. Of the natural breeding grounds of this species, but little is known in this section of the State of Illinois, beyond the fact of their existence along the Des Plains River at Riverside. In general terms, it may be inferred that the natural habitat is along the border of streams (J. H. Comstock[1]), about ponds (W. S. Blatchley[2]), in the vicinity of mud flats and low marshy places. The species is sub-aquatic in habit and widely distributed. (Lawrence Bruner[3]).

The predetermining causes of the singular flights noted above, may have been induced one way or another by the extreme dryness of the fall seasons of 1892–3. Indeed it is safe to assume that these conditions played a direct part, as will be

[1]Introduction to Entomology.

[2]From specimens so labeled in my collection.

[3]MS. letter.

seen from the following observations. On September 16, 1893, it was observed that the large stream at Riverside, a few miles west of Chicago, was so low that in many places one could travel across on the limestone bed, a thing before impossible. Along the banks of this stream Orthoptera appeared uneasy and much affected by the heat prevailing at the time. To the southeast and southwest, the directions from which the Grouse Locusts were blown, for miles the broad stretch of marshes, sloughs, small streams, ponds and lakes were dried, changing decidedly the topography of the districts. The effect upon animal life was to cause the shifting about of many kinds. The young grasshoppers, unusually favored, passed on to maturity aided by a scarcity of birds, their natural enemy, moreover, circumstances on every side being favorable, allowed excessive numbers to develop. Multitudes infested the regions where usually a few existed. By late fall the soil was baked by the heat, giving rise to a difficulty in finding a suitable place to deposit their eggs. Later, still further changes were enacted, for those habits ordinarily sedentary, now took on a tendency to be nomadic. Simultaneously, a kind of restless irritation took possession of the insect. Rising in the air in short flights to rid themselves of distress, aimlessly they pursued these movements through the day seeking for shelter. Ere long, a wind rushing in to take the place of the rarefied air, moving upward, bears off to distant points those caught up in its irresistible powers. Upper air currents may blow from three to twenty miles an hour, so basing an estimate on these grounds, a day's flight may be approximated at from twenty to one hundred miles. When subjected to a test the Grouse Locust's flight, ordinarily, is quite prolonged, being swift and noiseless. Referring again to the map Fig. 4, (shaded portion) an idea may be gained of the local flights of this little locust. If the furthest point be placed at one hundred miles distant from Chicago, the local point of observation, taking into consideration also the specimens found, the section of northeastern Illinois including the Kankakee River and its branches, the outlying marshy districts, various streams, ponds and tributaries of the Illinois River and the section

swept as shown on the shaded portion of the map in the north western corner of Indiana, contributed specimens to the flights. While more or less speculative, this paper is a step toward establishing a knowledge of the migrations in the Grouse Locust, of which little has been said by previous writers.

Explanation of Plate, No. XIII.

Fig. 1, 2 and 3, Tettigidea lateralis Say, all natural size; from nature.

Fig. 1. Female with wings extended.

Fig. 2. Seen from above.

Fig. 3. Side view.

Fig. 4. Map showing flights of T. lateralis in 1893. Clouded area indicating supposed habitat and section covered by the flights.

[c]. Chicago, local point of observation.

Chicago, Feb., 1894.

A GLACIAL ICE DAM AND A LIMIT TO THE ICE SHEET IN CENTRAL OHIO.

BY W. G. TIGHT.

The great continental glacier of the Plistocene will ever present many interesting problems to the student of those times. Its effects may be grouped under two heads; first, the general and widespread results of glacial action, and second, the local and minor effects produced by the action of local forces.

Believing that a careful study of these limited phenomena will help to illustrate some of the larger problems and enable us to gain a better understanding of the geological history of Plistocene times, the liberty is taken to present a few points of surface geology of a very limited region. It is hoped, however, that the accompanying map and sections will prove of interest.

Licking County lies near the center of Ohio, and is drained by the Licking River, which is formed at Newark by the confluence of three streams, The North and South Forks and Raccoon Creek. These streams form a hydrographic basin which is very nearly co-extensive with the county lines. The Raccoon Creek and North Fork rise in the western and northern portions, which are rather high lands; they flow through broad and open valleys, ranging from one-half to one mile in width, between the Waverly hills.

The valleys are filled with drift to a depth of 100 to 150 feet, increasing in depth toward their lower portions until at Newark the gas well borings show a valley filling of over 300 feet. These two streams are of rapid fall, ascending 250 to 350 feet in the 40 to 50 miles of their lengths.

The South Fork rises on high ground in the south-western portion of the county, flows south and east to near the Licking Reservoir, which lies about 125 feet above Newark, from this point the watercourse is almost due north to Newark.

Along the east side of the North Fork, the hills rise rapidly to an elevation of about 250 to 300 feet, as they also do along the east side of the South Fork. Standing on these hills and looking west the country appears to gradually rise, but no very high hills are visible in this direction. A level, however, reveals the fact that the land to the west is nearly as high, but is so filled in with drift that only the tops of the hills appear above the general level.

In a few words, then, the conditions are these: waters flowing from the north, west and south, meet at near the center of the county and start due east, flowing a few miles over a broad flood plain, and then plunging directly into the hills of the eastern portion of the county and finally reach the Muskingum at Zanesville.

As the Licking River leaves the open plain it enters the hill country in a narrow gorge with perpendicular walls 50 to 100 feet high, and the hilltops, only a few hundred feet back on either side, rise 300 feet higher. This gorge is commonly known as the Licking Narrows, and is the subject of this sketch.

For about the first mile of this narrow cut there are two or three large curves, but the gorge is on an average about 500 feet wide, and confines the river in narrow limits. The Baltimore and Ohio Railroad makes many rock cuts in order to get along on the south side, and there is scarcely room for the towpath of the canal on the north side. The canal is in the river through this gorge.

The left-hand margin of the map, plate XIV, represents the river at the center of the last curve of this mile of gorge. The walls at X are 45 feet high and overhanging, showing a large amount of undercutting on the curve. The heavy shaded line represents the outcrop of the Waverly or Logan Conglomerate, and wherever exposed presents an escarpment with an elevation represented by the figures on the contour lines.[1]

The last curve of the gorge referred to above, extends to about O and P, at which point the curve of the next sigmoid

[1] All vertical measurements are from the water level in the river, which is constant on account of the dam below.

begins. The gorge runs on past L m to the center of the next curve at OO, completing the curve at the point n.

The river, however, does not follow this course, as will be seen by following the shaded portion which represents the present river course, but turns at a right angle and runs through a rock cut 150 feet wide, with overhanging walls at both g and c′.

Just south of c′ the railroad has made a rock cut 45 feet deep on a very sharp curve in order to get through the gorge. The rock g, known as Black Hand Rock, stands out with a bold front 45 feet high and 250 feet long next to the river, where the tow-path of the canal had to be blasted out. The rock slopes on its top toward the north, and presents an overhanging wall about 20 feet high on that side.

Within the large open area of the unoccupied curve north of g there is a low mass of rocks presenting the form indicated at m, with a vertical rock exposure 10 feet high on the south side of the mass and gradually falling off into the lower channel OO, which is only 4 to 5 feet above water level. At n, and between g and m, are ponds of water on a level with the water of the river. The channel, between g and m, is about 70 feet wide, while that between m and L is 200 feet also between g and the vertical cliff H, on the east side of the channel, is 290 feet.

Continuing the large curve L, OO, n southward to R, there is, on the east side, a long, straight bluff, SS, 45 feet high at the present river front, and gradually decreasing to about 8 feet at its southern end. On the high ground between X and this channel there is a light drift covering as indicated by the dotted portion. This drift covers the west wall of the channel except at Y, where the rock is exposed. At YY there is no escarpment, but the high hill presents a very distinct curve as is shown by the contour lines. Between Y, YY, Z and the double cross, there is a low drift plain with a form shown by the contours. The river does not follow this low gap which is nowhere over 15 feet above its present level, but has cut a channel through the rocky spur H and S, 300 feet wide and 45 feet deep to present water level. The river here has about 30 feet of water.

At K is a rock with 25 feet vertical front, and at T a rocky projection 45 feet high, through which the river has also cut, while there is an open channel 350 feet wide between K and HH, obstructed only by a gravel trail 15 feet high, extending from K to a low rocky exposure at KK.

The rocks S and T are also separated by a channel about 250 feet wide, presenting vertical walls for a short distance back from the river, and indicated farther south by a depression in the drift filling.

At FF is a high hill with a rock cliff 25 feet vertical. At u u there is a low rock wall which is extended to the dam at F. Wells in the drift terrace south of w show a buried channel there 50 to 75 feet deep.

By tracing out the curves and sigmoids indicated by these rocky walls, evidence is found for two distinct rock gorges, besides the one occupied by the present river, as shown by the heavy, dotted and broken lines respectively.

To make these data as clear as possible, five sections drawn to scales are presented in plate XV. These sections are taken along the lines bearing the same letters on the map and in the same position. The continuous, interrupted and crossed lines represent the courses of the rocky gorges, while the dotted portions represent the estimated depths of the drift-filled channels.

The interpretation of this peculiar locality is by no means certain. We venture an explanation which, in the light of Prof. I. C. Russel's investigations on existing glaciers, seems to me quite possible. There is abundant evidence for believing that the preglacial drainage of Licking County was to the south, and that a great morainic dam backed the water up until it broke over a col into the Muskingum basin.[2]

This col was at the point represented by C at the extreme left of plates XIV and XV. On each side of this low divide there was a ravine cut into the Waverly Conglomerate.

As the water rose over the divide and began to cut it down, the gorge produced by this cutting to the west of the point C

[2] Full description of evidence for these conditions will be found in Bulletin of Scientific Laboratories of Denison University, Vol. VIII, Pt. 2.

conformed exactly to the pre-existing ravine running in that direction, as this ravine would represent continuously the lowest point in the divide, hence we find the upper part of the present gorge showing no marked changes in its position.

The ravine on the down slope toward the east, however, whose outline is represented on plate XIV by the dotted line, and on plate XV by the crossed line, fared quite differently. A large volume of water suddenly attempted to occupy a small ravine. The result was that the first curvature was greatly increased and a great undercut made at X. Deflected from this point it struck the opposite or left bank of the ravine at m, and as it cut farther back into the great curve at OO, it also cut deeper and a small remnent of the left bank of the original ravine was left at m. The outline of this channel is represented by the broken line.

After making the curve at OO where considerable undercutting is also shown, the waters took a straight shoot south into the old ravine again.

At the south end at YY, the old ravine, as shown by the dotted lines, made another sharp curve similar to the one at g, and passed north between S and T to another curve at H H, thus making the next loop of the sigmoid which passed southeast through the point u.

Since the rush of glacial waters was not able to make the short turn at Y Y, and since the original surface level was lower than at H, they broke over the divide and made a new cross channel tending north-east in the direction Z u, and chocked up the old ravine between S and T with sediment. As the lower level was reached and the velocity checked, the lower courses of the intersected ravine were filled up with material cut from the gorge above. Evidence of these buried channels is found in many wells in the village of Toboso, just south of the river dam, which is across the present river at F.

There yet remains the great question, Why the river ever left this second channel which it had cut out at such a great depth and made a new one for itself straight across the rocky barriers at g c′, H S, and KT. If these were at the ends of the loops, or if the old channel was anywhere obstructed with

drift, the explanation would be more simple. As it is, there seems to be but one solution to the problem to suggest, and we believe the facts point very strongly toward its support. This region is just on the eastern border of the Scioto lobe of the ice sheet. No glacial till is reported south or east of this point in Ohio. Does it not seem reasonable then that the great ice front or a local spur of it extended to this point and presented a front along a line represented by the north bank of the river in the line of L, m, g, n, H, K, and F, and remained there long enough for the river waters deflected at X to strike this ice barrier at L m, and, deflected along its front, to cut through the narrow and jointed rocky spurs at KT, then at HS, and last at g c′. If this is true, it will serve as a point in evidence of the probability of ice dams and a point to fix a limit to the ice sheet itself.

For fuller elaboration of the data of this region and other facts in evidence of the very near position of the ice front, see Bulletin of the Scientific Laboratories of Denison University, Vol. VIII, Pt. 2.

EDITORIALS.

—The U. S. National Academy of Sciences has been in a state of paralysis for now two years in the matter of electing members, after having been unable to fill its vacancies for a considerably longer period. This is not due to the lack of suitable candidates, but rather owing to the impossibility of concentrating a sufficient number of votes on any one candidate to elect him. This is in turn due to the fact that there is a disproportionate number of members devoted to the physical sciences, as compared with those devoted to the natural sciences. In the present membership there are, according to a committee of the society, fifty-eight members devoted to the physical, and thirty-one members who represent the natural sciences. It is natural that under such circumstances, the members of the latter class should refuse to add to the members of the former class. It is true that of the seven candidates presented at the election which has just failed, four represented the natural, and three the physical sciences. But the gentlemen present who represent the physical sciences could not be prevailed on to elect an additional member of the division of natural sciences. This result is probably due to a want of concerted action, rather than to an intentional desire to continue the present disproportion between the classes. It is also due in part to the vote of members who do not attend the meetings, and who thus fail to receive information as to various points at issue. The preponderance of any one class naturally tends to perpetuate itself, and its effect is now so conspicuous that the necessity for some change in the mode of elections is obvious.

It is proposed to meet the difficulty by dividing the Academy into classes, each of which is to have a fixed membership, so that deficiencies may be known and filled. Such a system exists in the academies of most countries, and it materially aids in securing a just representation. The system should not, however, be too complex, since it is impossible to fix the correct proportion of membership of any of the special branches of science, which shall be always applicable. A few large divisions, whose cultivators for obvious reasons stand in a generally definite proportion to each other, or to the Academy, is about as much as is practicable in this direction. The committee already referred to, proposes that the Academy be divided into six classes, three of which embrace physical sciences, and two natural sciences, and one includes sciences which cannot be classed under either head. This

classification tends to perpetuate the disproportion already referred to; omits reference to some sciences; and makes no distinct division for applied science. We now refer to a letter addressed to the committee, which appears in the department of Scientific News this number of the NATURALIST, in which the following division is proposed: Class I.—Physical Sciences, 35 members; Class II.—Natural Sciences, 35 members; Class III.—Anthropological Sciences, 15 members; Class IV.—Applied Sciences, 15 members. The sciences included in each of these classes are enumerated in the letter in question.

—A bill has been recently introduced into Congress, providing for the establishment of a "National Academy" of twenty-five members. Of these Congress is to appoint the first five members, and these are to appoint the other twenty. These twenty-five are to represent "literature, science, fine arts and invention." We understand that Gen. Lewis Wallace has drawn up the bill.

The sponsors of this project appear to be unaware of the existence of the National Academy of Sciences of one hundred possible members. They also display an extraordinary exclusiveness in entertaining the supposition that the departments of human effort mentioned in the bill can be properly represented by only twenty-five men. Taking the National Academy of Sciences for granted, it might be supposed that an Academy of Arts might be similarly constituted. In such a case, membership, as in the Academy of Sciences, would be awarded on account of original work done. Literature, Music and the Fine Arts would be encouraged by such an organization, were the qualifications for membership and the number of members strictly defined. The difficulty in doing this, and in applying the rules in the concrete, would be greater in the case of the arts, we apprehend, than in the case of the sciences. It is also quite probable that fifty names, rather than one hundred, would embrace the list available at the present time in this country.

It is hardly possible that the bill now before Congress can become a law in its present shape. The scientific element must be eliminated as being already provided for. The best literary men and artists of the country must decide whether such a body could be so constituted as to be truly representative of the best work or not. Geographical claims, so dear to the American heart, must be ignored in this matter, as it is in the Academy of Sciences; and the usual preference of most people for their friends will be an ever present difficulty to be met and overcome. On the whole, however, we suspect that such a body, properly

protected, would be an encouragement to original production in the arts, as the Academy of Sciences is to those engaged in the pursuit of scientific research.

—The recent celebration at Jena, in commemoration of the sixtieth birthday of Professor Ernst Haeckel, was a deserved compliment to a great naturalist. The range of Professor Haeckel's work covers the three fields of usefulness possible to the naturalist, viz.: special work, generalization, and popularization. His well known researches on the Radiolaria, sponges, corals and Medusæ are monuments of industry and skill. His generalization of the phenomena of the earliest embryonic stages is the frame-work of embryology. His speculations as to the phylogeny of the Vertebrata have been often confirmed by paleontology. His delightful Travels in Ceylon have brought him before a wide and interested public.

PLATE XIII.

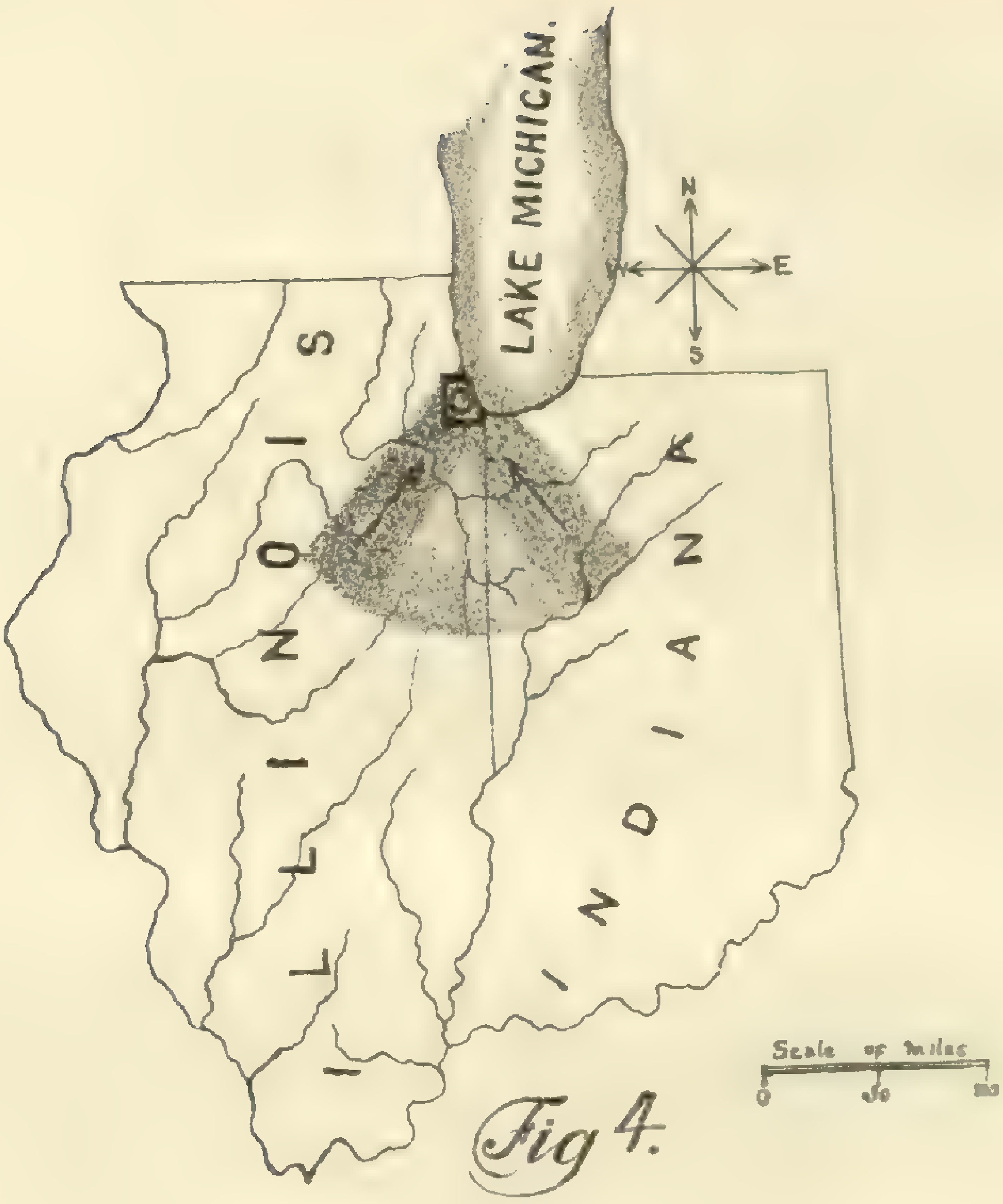


Fig 4.

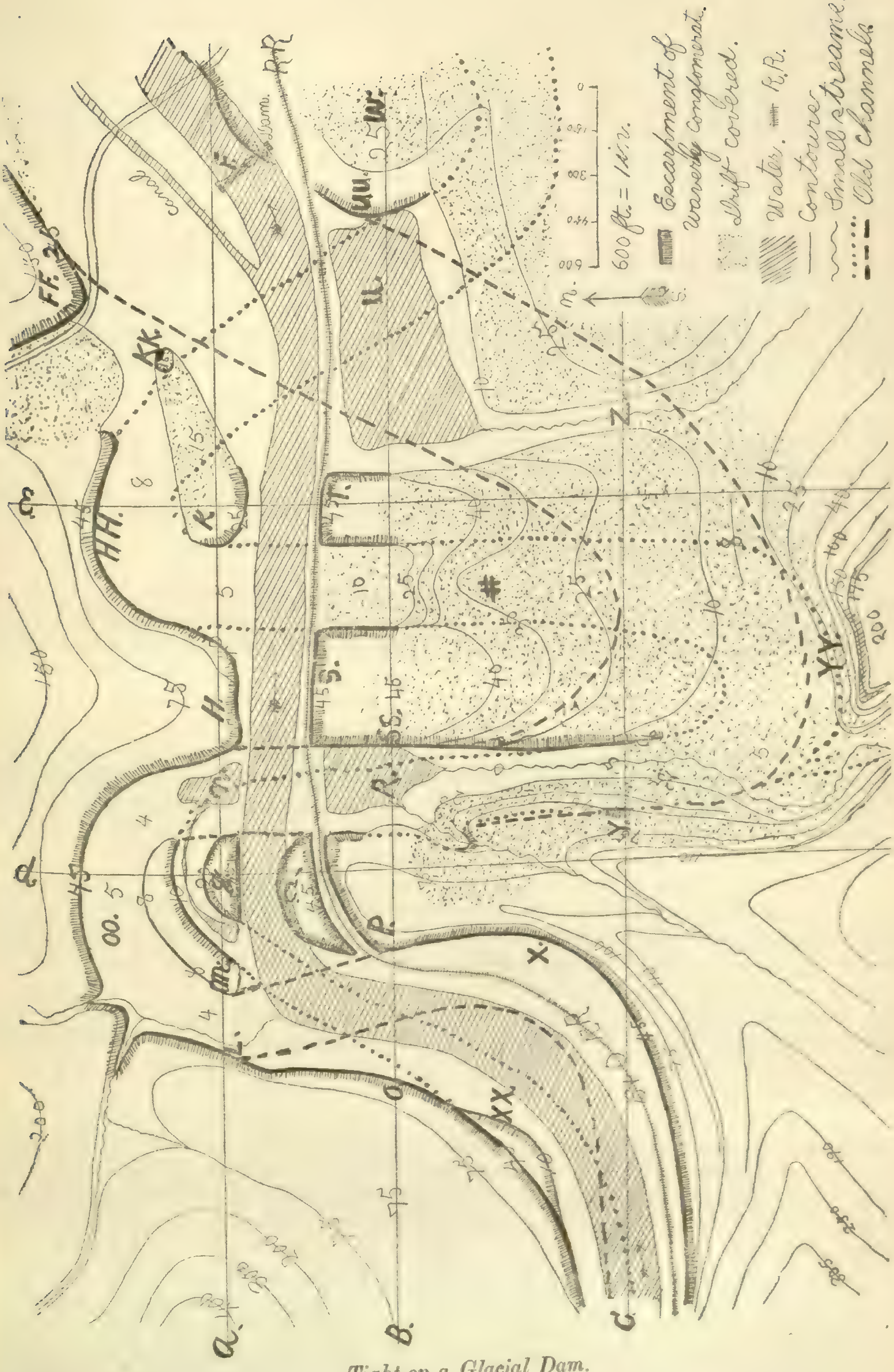
Fig 3

Fig. 1.

Fig. 2.

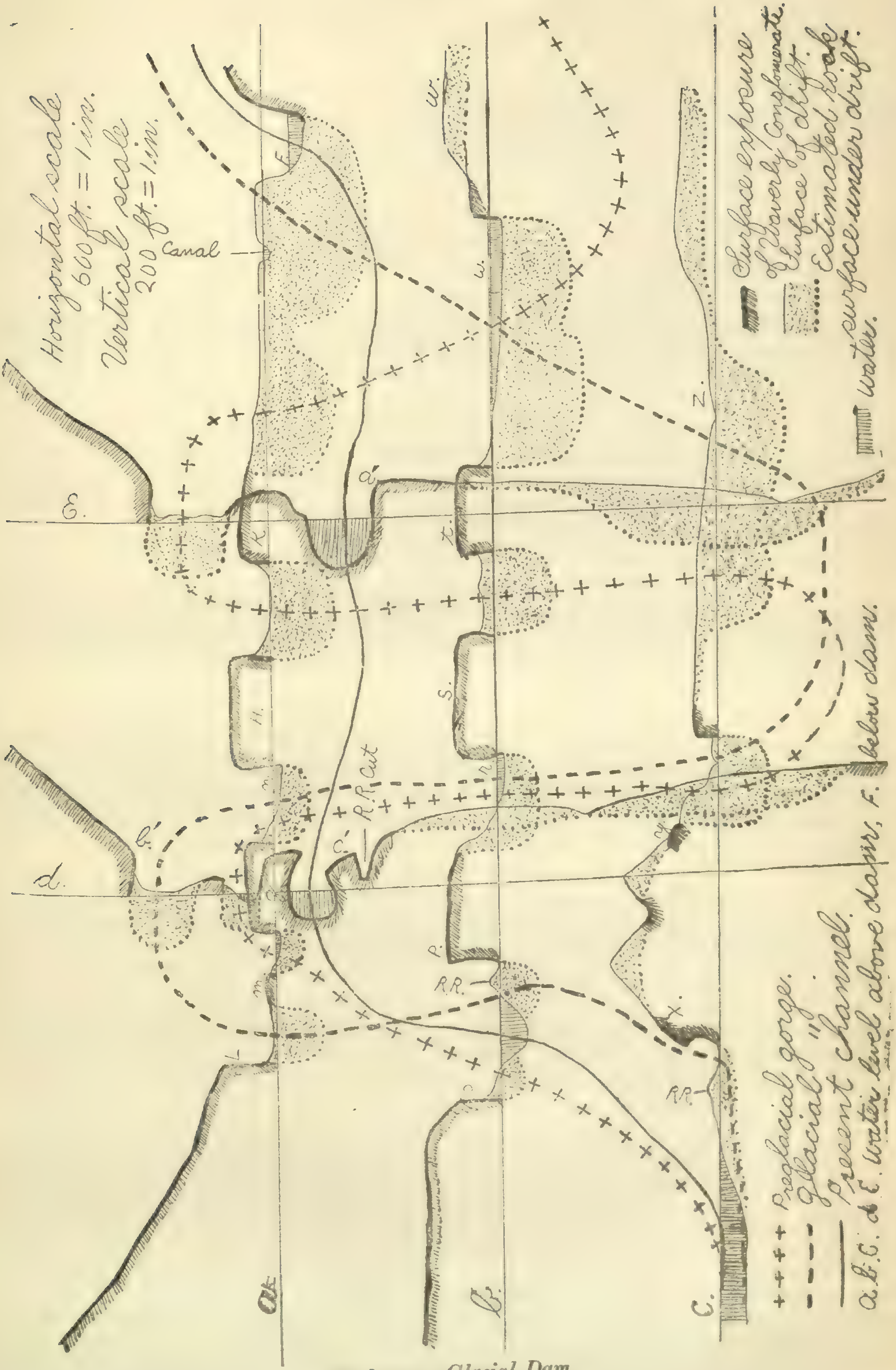
Tettigidea and its Migrations.

PLATE XIV.



Tight on a Glacial Dam.

PLATE XV.



Tight on a Glacial Dam.

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RECENT LITERATURE.

The Woods Holl Lectures.[1]—It is with pleasure that we welcome the second of the series of lectures delivered at the Woods Holl Laboratory, for they deserve a larger audience than that for which they were especially prepared. In the present volume we have ten lectures, each adequately illustrated, most of which are devoted to the presentation of the newest thought upon subjects which are most prominent in the biological world to-day. They are, moreover, not résumés of others' work but actual contributions to knowledge by original investigators. In his lecture on the "Mosaic theory of Development," Professor E. B. Wilson, admitting that the extreme form of this theory is untenable, endeavors to show that in a modified shape it contains elements of truth, "that we may consistently hold with Driesch that the prospective value of a cell may be a function of its location and at the same time hold with Roux that the cell has, in in some measure, an independent power of self determination due to its inherent specific structure." Professor E. G. Conklin discusses certain phenomena in the fertilization of the ovum of Crepidula, a form which is especially favorable for the study of the archoplasmatic structures, which he maintains are even more important in the phenomena of impregnation and mitosis than the nucleus, taking as they do the initiative in all the wonderful manifestations of fertilization and cleavage. Further he advances the thesis that the nucleus and especially the chromatin is not of necessity the sole bearer of heredity, a position, which if proved to be true, destroys the whole fabric of Weismann's evolution, as at present constituted.

The third lecture by Professor Jacques Loeb, of Chicago University is upon some facts and principles of what he terms physiological morphology. First he deals with heteromorphosis, that is, describes his experiments with certain Hydroids, there, by reversing the positions, etc., he was able to make roots produce polyps and the free end to grow roots. Next he outlines his experiments with other forms in which there was marked polarity. The third subject is the effect upon certain forms of a change in the density of sea water, while the fourth deals with the production of double and multiple monstrosities in sea urchins, by putting them a short time into diluted sea water and then

[1]Biological Lectures delivered at the Marine Biological Laboratory of Woods Holl in the summer session of 1893. Boston, 1894. 8°. pp. 242, $2.15.

back into normal. In the concluding section, all life phenomena are referred back to chemical processes.

Under the title Dynamics in Evolution, Professor Ryder reiterates his mechanical ideas, explains the changes in form of an amœba by differences of surface tension and this again by chemical action. He has no sympathy with "biophores" and "gemmules" and thinks that experimental investigation in embryology will make no firm progress until the mischievous influences of those speculations which deal with "germ plasms" and the like have been entirely eradicated from the present generation.

Dr. Watase, treating of the nature of cell organization, thinks it not improbable that in the cell we have a symbiotic structure, the nucleus and the cytoplasm living together in a way analogous to that presented by the algæ and the fungus in the lichen. Professor Whitman's lecture on the Inadequacy of the Cell Theory of Development is most suggesitve, but is so condensed as to be beyond any adequate abstract. In a word it is that in our discussions of the cell as a unit, especially in the experimental embryological researches, the tendency has been to regard the cell as all in all, while in reality the whole organism is the entirety.

The thesis which Dr. Howard Ayers maintains in his study of the Pacific Hagfish *Bdellostoma dombeyi*, are that this form is very variable and that the number of gill slits cannot be used as a criterion for separating genera and species; further that it is a primitive rather than a degenerate type; and lastly that a study of the ears of this animal show that these organs cannot be considered as organs of equilibration.

The next two lectures touch upon the Botanical side. Dr. W. P. Wilson discusses the influence of external conditions on plant life and presents an essay which goes far toward showing that such striking acquired characters as the knees of the bald cypress are not inherited but will disappear in a single generation with changed conditions, and that the same is true of the remarkable roots of the Black mangrove of Tropical America. The other botanical lecture, by Professor J. Muirhead Macfarlane, treats of irrito-contractility in plants, in which he shows that this phenomenon is much more common than is ordinarily supposed, but that there is usually a latent period and that in many instances the stimulus has to be repeated before marked manifestations are produced.

The last lecture—upon the Marine Biological Stations of Europe by Dr. Bashford Deane—is familiar to our readers. The volume closes

by a general statement, by the Director, Professor C. O. Whitman, of the work and aims of the laboratory from which we learn that already 75 papers have been published, the direct outcome of the laboratory in its six sessions.

The volume is well printed and we look for a large sale for it, for it certainly should be in the hands of every one who wishes to keep himself informed of the present tendencies of biological science.

Report of the United States Fish Commissioner for 1889-91.[2]—This volume contains in addition to the official report of the Commissioner, the results of inquiry respecting Food-fishes and the Fishing grounds of the United States, by Richard Rathbun, and a statement of the Methods and Statistics of the Fisheries, by H. M. Smith. together with six papers published as appendices to the report. Among these is Hæckel's "Plankton-Studien," A Comparative Investigation of the Importance and Constitution of the Pelagic Fauna and Flora, translated by George W. Field.

Mineral Resources of the United States, 1892.[3]—This volume shows the progress made in the development of the mineral products of the United States in 1892. The statistical tables are carried forward from former reports to the close of 1892, but the descriptive matter has been brought up to a late date in 1893.

[2]Report of the United States Commissioner of Fish and Fisheries for 1889–91. Washington, 1893.

[3]Mineral Resources of the United States for 1892. David T. Day, Geologist in Charge. Washington, 1893.

General Notes.

GEOGRAPHY AND TRAVELS.

The Grand Falls of Labrador.—For many years vague reports of a great waterfall in Labrador near the head waters of the Grand River have induced men to explore the interior plateau of this region, but no satisfactory account has been given of the appearance of the "Falls" until the recent publication of the results of an exploration undertaken by Mr. Henry G. Bryant of Philadelphia to verify the reports as to the height and location of this natural wonder.

In company with Prof. Kenaston of Washington, D. C., Mr. Bryant arrived at Rigolet in Hamilton Inlet, July 23d, where they embarked on a small schooner which carried them to the head of the interior basin known as Melville or Grosswater Bay. Here Mr. Bryant tried for Indian coöperation in his enterprise but could not overcome their superstious fears. They firmly believe that death will soon overtake the venturesome mortal who dares to look upon the mysterious cataract. The party that finally started up the Grand River on August 3d consisted of Mr. Bryant, Prof. Kenaston, John Montague, a young Scotchman, and Geoffrey Ban, a full-blood Eskimo. The trip was made in a strong river boat eighteen feet in length and they took with them a canoe for use in the upper reaches of the river. By noon of the second day the party reached Muskrat Falls, where a chain of hills encroaches the bed of the river, contracting the channel and presenting a rocky bulwark, through which the stream has forced its course. The drop of the falls was ascertained to be thirty-six feet. Here was necessitated the first carry, a tedious operation which occupied a day and a half. The subsequent advance of about 175 miles up the river was by the method known as "tracking." That is, a rope was tied to the gun-wale just aft the bow. To the shore end broad leather straps were attached. This constituted a harness for three of the men who tugged away along the rocky back while the fourth man, by means of an oar lashed to the stern, steered a devious course among the rocks and shallows of the river. Sandy banks and glacial boulders insecurely lodged afforded a precarious footing for the "team," and stretches of rugged cliffs exercised their ingenuity in making progress. Wading in the water was often the only resource.

On the fourth day Porcupine Rapids was reached, a distance of fifty-seven miles from the mouth of the river. Here was a notable increase in the size of the firs and spruces. Deposits of magnetic iron ore were observed on the banks of the river. The next day the travellers passed through a widening of the river known as Gull Lake. This is a favorite resort of the Canada goose and its waters contain large numbers of white-fish, pickerel and suckers. Above the lake the valley of the river contracts gradually; the sandy terraces disappear, and sloping banks, strewn with erratics, are encountered for many miles. The Gull Island, Horseshoe, Minnipi and Mouni Rapids were conquered in turn. In the swollen condition of the river, the struggle with these wild rapids was long and stubborn. Mouni Rapids extend over a longer distance than any of the others, and aneroid readings show a greater drop here in the bed of the river than at any other point. It was here that the travellers met with an awkward adventure, which Mr. Bryant relates in the following graphic manner.

"We were approaching a rocky point past which the water dashed with angry violence. It was our custom on reaching such a place to first detach the canoe, and then shove out the boat obliquely from the still water to allow her bow to fairly meet the swifter current. On this occasion, while Montague and I, facing up stream were waiting on the bank above for the signal to advance, the boat, through some carelessness, was pushed out from the quiet eddy squarely into the swift water. The full force of the torrent struck her abeam, and away she swept down the stream like a thing possessed. Taken unawares, no time was given to throw off the leather straps from our shoulders, and instantly we were thrown from our feet and dragged over the rocks into the river by the merciless strength of the flood. Most fortunately for me, the circular strap slipped over my head as I was being dragged through the water. Montague's also released itself, and the runaway sped down stream a quarter of a mile before it was stopped. On clambering up the bank I found Montague stunned and bleeding from a scalp wound. Aside from some abrasions of the skin, I was none the worse for my shaking up, and after a brief delay Montague revived and we resumed our 'tow-path' exercise."

Lake Wanakopow was reached August 20th. This romantic sheet of water, less than a mile in width but 35 miles in length, is surrounded by low mountains of granite and gneiss, from whose cliffs and wooded headlands cascades leap into the lake, their silvery outlines contrasting with the environment of dark evergreen foliage. A sounding taken near the middle shows a depth of four hundred and six feet. Mr.

Bryant considers this narrow elevated basin to be of glacial origin, the presence of great numbers of boulders and the rounded appearance of the hill summits pointing to a period of ice movement.

The middle of Lake Wanakopow marks the limit of Mr. Holme's exploration. On his map he places the Grand Falls thirty miles above the head of the lake, with the river entering the lake from the west. Mr. Bryant found, however, that the river enters from the southwest, and the distance from the lake to the rapids below the fall is fifty-three miles.

Finding it impossible to draw the boat through the wide shallow rapids which they afterwards found extended for twenty-five miles before the fall, the explorers resolved to find an old trail they had heard of from a reliable Indian at the Northwest River Post, which leads from this point on the river through a chain of lakes on the table-land, thence to the waters of the Grand River some miles above the Grand Falls. The plan was to follow the old trail for several days then leave it and strike across country in the direction of the river.

A search of three days for the trail was at last successful and the party advanced across five lakes and four "carries." At the north-western extremity of the sixth lake they left the trail and prepared for the tramp across country, which, according to Mr. Bryant, is of the most desolate character. It is undulating, sparsely covered with stunted spruce trees, Labrador tea-plants, blue-berry bushes, etc., among which great weather-worn rocks gleam, while on all sides white patches of caribou moss give a snowy effect to the scene. Shallow lakes reflect the fleeting clouds, their banks lined with boulders, and presenting a labyrinth of channels and island passages. Low hills rise at intervals, but the general effect of the landscape is that of, flatness and monotony. No living thing was encountered. Just before sunset a column of mist rising like smoke against the western sky proved the accuracy of their reckoning, but it was impossible to reach the river that night.

The next day, Sept. 2d, after a rough march over rocks and bogs, they emerged from the forest near the spot where the river plunged into the chasm with a deafening roar. The following description by Mr. Bryant is so vivid that we cannot refrain from quoting it entire.

"Standing at the rocky brink of the chasm, a wild and tumultuous scene lay before us, a scene possessing elements of sublimity and with details not to be apprehended in the first moments of wondering contemplation. Far up stream one beheld the surging, fleecy waters and tempestuous billows, dashing high their crests of foam, all forced onward with resistless power towards the steep rock, whence they took their wild leap

into the deep pool below. Turning to the very brink and looking over, we gazed into a world of mists and mighty reverbations. Here the equisite colors of the rainbow fascinated the eye, and majestic sounds of falling waters continued the pean of the ages. Below and beyond the seething caldron the river appeared, pursuing its turbulent career, past frowning cliffs and over miles of rapids, where it heard 'no sound save its own dashings'. The babel of waters made conversation a matter of difficulty, and after a mute exchange of congratulations, we turned our attention to examining the river in detail above and below the Falls."

"A mile above the main leap, the river is a noble stream four hundred yards wide, already flowing at an accelerated speed. Four rapids, marking successive depressions in the river bed, intervene between this point and the Falls. At the first rapid the width of the stream is not more than one hundred and seventy-five yards, and from thence rapidly contracts until reaching a point above the escarpment proper, where the entire column of fleecy water is compressed within rocky banks not more than fifty yards apart. Here the resistless power is extremely fine. The maddened waters sweeping downwards with terrific force, rise in great surging billows high above the encompassing banks ere they finally hurl themselves into the gulf below. A great pillar of mist rises from the spot, and numerous rainbows span the watery abyss, constantly forming and disappearing amid the clouds of spray. An immense volume of water precipitates itself over the rocky ledge, and under favorable conditions the roar of the cataract can be heard for twenty miles. Below the falls, the river turning to the southeast, pursues its way for twenty-five miles shut in by vertical cliffs of gneissic rock which rise in places to a height of four hundred feet. The rocky banks above and below the falls are thickly wooded with firs and spruces, among which the graceful form of the white birch appears in places."

Attempts to secure photographs of the falls did not meet with success, it was difficult to obtain a good point of view, and, besides, a combination of poor light and mist from the falls cause a lack of definition in the photographs.

Prof. Kenaston found by measurement that the height of the main fall is 316 feet and the vertical height of the chute is 32 feet; making the total descent from the head of the chute to the surface of the water in the chasm about 348 feet. The Grand Falls are then nearly twice as high as Niagara, and are only inferior to that cataract in breadth and volume of water.

The appearance of the sides of the gorge below the falls and the zigzag line of the river suggests that the falls have receded from the edge of the plateau to their present position, a distance of twenty-five miles. If it has taken six thousand years to cut the Niagara gorge where the water acts on a soft shale rock supporting a stratum of limestone, what an immensity of time is involved in assuming that the Grand River Cañon has had a similar history when it is remembered that the escarpment of the Labrador Falls is of hard gneissic rock.

Among the results obtained by the expedition are the measurement of the height of the Grand Falls; the determination of the altitude of the table-land of southeastern Labrador; map of the lower course of the Grand River, from compass survey; meteorological observations extending over the six weeks of the journey; botanical collections illustrating Labrador flora; ethnological collections illustrating life and customs of mountaineer Indians and Eskimos. (Bull. Geog. Club vol. I, no. 2, 1894.)

GEOLOGY AND PALEONTOLOGY.

Continuity of the Glacial Epoch.—The question of *Pre*-glacial or *Inter*-glacial erosion of the rocky gorge of the Ohio River and its tributaries is made the subject of a paper by Rev. G. Frederick Wright in the Am. Journ. Sci., March, 1894. The writer, as it is well known, maintains the former theory, and gives the following summary of the course of events connected with the Glacial period, stating more fully than has heretofore been done how those who question the long interglacial epoch can account for what has been called the moraine of the second Glacial epoch, and for the river terraces which everywhere, east of the Mississippi River, head near the moraine

"1st. The earlier portions of the Tertiary period were characterized, throughout all the northern hemisphere, by low altitude of land and a warm temperature even in close proximity to the pole."

"2d. A period of slow continental elevations of the regions which are now covered by Glacial drift, extending through some hundreds of thousands of years, was in progress late in the pliocene epoch. During this stage of events, the fiords which characterize the northern portions of both Europe and America, and the extensive rock gorges, like those of the upper Ohio River and its tributaries, were eroded."

"3d. Contemporaneously with this continental elevation at its maximum stage, and chiefly as a consequence of it, Glacial conditions characterized all the higher latitudes of North America and Western Europe. In eastern North America, the center of Glacial radiation was in the vicinity of James Bay. A land elevation of three or four thousand feet would perhaps have been sufficient to produce the Glacial conditions; but the accumulation of the Glacial ice would eventually raise the surface several thousand feet higher."

"4th. Before the climax of the Glacial period, and perhaps in consequence of its burden of ice, the glaciated area began to sink until the land was, north of the Great Lakes at any rate, several hundred feet, at least, lower than it is now. But for some time after the beginning of the subsidence of the land, the rate of accumulation of ice would be greater than that of the subsidence, so that the general level of the glacier continued to rise. Thus the maximum extension of the ice field was actually reached but a short time before the decline of the period set in."

"5th. As suggested to me by Mr. Upham, 'The frontal slope of the ice surface was then less steep than when the warmer climate, bringing the end of the Glacial period, had begun to melt away the southern border.' At the maximum of extent, the slope may be represented as terminating in a very gentle declivity, allowing some transportation of bowlders to the boundary, but not generally so steep as to produce there any well defined moraine. In the glacial recession the warm sunshine and rains were especially efficient, on a belt a few miles or a few tens of miles wide adjoining the boundary, so that when any temporary colder series of years caused a halt or slight re-advance, a moraine would be formed."

"6th. From the time the ice first entered the headwaters of the Allegheny, the Susquehanna, and the Delaware Rivers, the silting up of their channels began. This was effected largely by means of the excessive amount of the Glacial debris brought within reach of the streams. But during the earlier retreat of the ice front from its maximum extent, the silting was facilitated by the differential northerly depression, which existed. During a part of this time, also, it was facilitated in the Ohio Valley by the Glacial dam at Cincinnati."

"7th. After some thousands of feet of ice had melted off, relieving the land from a large part of its burden, the re-elevation of the continent began; (and, as probably the most of the sedimentation of the pre-glacial river gorges had been effected during the earlier portion of this period of recession), there was then an indefinitely prolonged period of reëxcavation by continuous torrents of comparatively clear water, facilitated in the Ohio Valley by the wearing away of the Cincinnati dam, which increased by so much the gradient of the stream."

"8th. When equilibrium had been established again, the land was at about its present altitude, but was still covered to a considerable depth with ice north of the most prominent moraines. The great size of these moraines is partly due to the vast amount of englacial material held in the lower strata of the ice."

"9th. The deposits of the so-called Champlain epoch near the margin of the glaciated area were considerably earlier in time than those which settled over the Champlain Valley itself, since no deposits could take place there until the ice had retreated from the area; but these deposits are properly classed together as Champlain, since they belong to one epoch of general movement."

"10th. So great a complication of causes was connected with the production of all the phenomena connected with the period, that there

were doubtless many oscillations of the ice front, both during the general advance and the general retreat of the ice sheet. The extent and continuance of these oscillations is to be learned from study of the buried forests and vegetal deposits which lie between the earlier and later sheets of till, and by such instances of erosion as may be clearly proved to be inter-glacial. But there does not seem to be evidence of any oscillations of the front sufficient to break the proper continuity of the period."

The Colorado Formation and its Invertebrate Fauna.[1]—In a study of a collection of fossils from southern Colorado, Mr. T. W. Stanton found it necessary to review, not only the species definitely assigned to the Colorado Formation, but also a number of doubtful ones vaguely referred to the Cretaceous of Utah and New Mexico. The results of his investigations are published as Bull. No. 106 of the U. S. Geol. Surv., an octavo volume of 189 pages, and forty-five plates. In the compilation of the species, the nomenclature and descriptions have been carefully revised in all cases where better collections or additional facts seemed to make it necessary. Thirty-nine species are believed to be new to science. Mr. Stanton gives a comparison of the lists of fossils to show that the invertebrate fauna of the Colorado formation cannot be subdivided into the well defined zones recognized in Europe, but the fauna on the whole may be regarded as the approximate taxonomic equivalent of the Turonian.

New Polyzoans from the Belgian Cretaceous.—Mr. Ed. Bergens is about to publish a descriptive work with plates of the Cretaceous Polyzoans collected near Limbourg, Belgium. In this work the author figures a score of colonies from the Maestricht formation (Fox Hills) of great rarity. Among the known species is an example of *Lichenopora diadema* Gldfs. with an ovarian cell completely developed; an entire colony of *Camerapora*; a colony of *Retecava clathrata* Gldfs. with the base rounded, figured in this rolled state as *Neuropora cretacea* by Von Hagenow.

The other forms are new and many of them are referred to new genera. The author recognizes the genus *Eschara*, although it is composed of heterogenous elements, in order not to augment uselessly the synonomy, for a study of the soft anatomy has not yet allowed a definite classification to be made. (Bull. Soc. Belge de Geol. Pal. et Hydrog. T. VII. 1893).

[1]Bulletin United States Geological Survey, No. 106. The Colorado Formation and its Invertebrate Fauna. T. W. Stanton. Washington, 1893.

Geological News.—General.—In regard to the term gneiss, Professor T. C. Bonney remarks that it covers a group of rocks rather different in character and very different in history. One (a common type) is a gneiss in consequence of an original structure, and remains very nearly in its original condition. Another (also common) owes its structure to pressure acting on a rock which had already solidified and had become crystalline. The Central Oberland and some parts of the Pennines afford examples. A third (rather rare and exceptional) is the result of the metamorphism of materials which were originally clastic. Such has been the origin of some of the banded gneisses in Sark, and more evidentally in a mass of rock near the base of the Allalin glacier where veins of intrusive granite exhibit a banded structure which can only be explained by a movement of the material while still in a plastic condition. (Geol. Mag., March, 1894.)

Archean.—According to Mr. Robert Bell, many of the long straight valleys in the Archean regions of Canada now occupied by river stretches, by long, narrow lakes, and by inlets of larger lakes are due to the decay and removal of wide greenstone dykes, together with belts of rocks between them. The writer instances the inlets of the northern part of Georgian Bay, Onaping Lake, Long Lake, Sepiwesk Lake with Nelson River, Mattagomi River and Lake Temiscaming. The latter is from one to two miles wide and has a length of 35 miles, but the channel is continued into Deep River. The writer estimates the depth of this excavation to be about 2,600 feet. Mr. Bell presents stratigraphical evidence to show that this valley existed before the date of the Niagara formation, and he believes that most of the valleys which mark the courses of the decayed dykes were formed before the deposition of the Paleozoic strata. (Bull. Geol. Soc. Am., Vol. 5, 1894).

Dr. U. S. Grant concludes, after study in detail of the granitic area near the eastern extension of the Mesabi range in Minnesota, that the rocks of this region are not altered sediment as has been thought heretofore, but that they are truly eruptive in nature and origin. They are sharply separated from the surrounding clastics, and of later date than those. (Ann. Rept. Minn. Geol. Surv. for 1892).

Paleozoic.—Among the Silurian Trilobites described by Messrs. R. Etheridge, Jr. and John Mitchell in Proc. L. S. N. S. W. issued March, 1894, are three new species: *Cyphaspis yassensis, C. horani* and

C. rotunda. The first is of interest as being the only Australian Trilobite in which the supposed auditory organs have been observed. These pores in *C. yassensis* are not situated in the facial sutures, but between them and the front rounded border of the glabella.

The Illinois State Museum has just issued a Bull. (No. 3, 1894) containing descriptions of new species of Invertebrates from the Paleozoic rocks of Illinois and adjacent States, described by Messrs. S. A. Miller and Wm. F. Gurley. The fossils comprise 4 species of Echinida, 49 Crinoidea and 4 Crustacea, referred respectively to 2, 29 and 2 genera. Eight page plates of drawings accompany the text, some of which are not as well executed as one would wish.

Mesozoic.—In a revision of the genus *Cycadeoidea* Buckland, Dr. Lester Ward refers to the collection of six fine cycadean trunks recently found near Hot Springs, South Dakota. All the cycadean remains thus far found in the southern part of the Black Hills occur in the area marked by Professor Newton as Dakota Group. The fact that no cycadean vegetation has yet been found in the extensive collections from the Dakota group of Kansas and Nebraska, led to a careful examination of the series thus classed by Professor Newton, which results in the following conclusion. The Dakota group of Newton is much more extensive than No. 1 of Meek and Hayden, and while the upper portion certainly belongs to the true Dakota, the lower portion very probably extends to near the base of the Cretaceous. The cycadean trunks belong to this lower portion, and may not differ greatly in age from those found in Maryland described by Tyson. (Proceeds. Biol. Soc. Wash., Vol. IX, 1894).

A collection of Cretaceous plants from Vancouver Island yields 50 species of which 27 are new. These are described and figured by Sir Wm. Dawson in Trans. Roy. Soc. Canada, Sect. IV, 1893. In this connection the author points out the value of fossil plants as indicators of climate and time.

Cenozoic.—A restoration of *Aceratherium fossiger* Cope has been made under the direction of Professor Williston for the Kansas University Museum. The skeleton is a "composite" made up, probably, of nearly as many individuals as there are bones. The different elements were selected from among many hundreds of specimens obtained from a fresh water Pliocene deposit near Long Island, Kansas. The

dimensions of the skeleton are as follows: Length, not including tail, 9 feet; height, 4 feet; greatest girth, 9 feet 4 inches. (Kansas Univ. Quart., April, 1894).

In discussing the mammoth remains in Canada and Alaska, Dr. G. M. Dawson notes that in the northwestern part of the continent they are abundant in, if not confined to the limits of a great unglaciated area there existing. This area comprises nearly the whole of Alaska and part of the adjacent Yukon district of Canada. No *mastodon* bones have been reported from this region. (Quart. Journ. Geol. Soc., Feb., 1894).

A collection of Tertiary Mammals is reported upon by Professor John Eyerman. The most of the specimens were obtained by Dr. Forsyth-Major, *in situ*, in southern France and Italy. The collection comprises 7 Insectivora; 3 Carnivora; 14 Rodentia; and 5 Ungulata. Of the Insectivora, one represents, according to Dr. Major, a new family and genus. Also there is one new genus of Murid rodents, closely related to the American *Paciculus* of Cope. (Am. Geol., Vol. XII, 1893).

Signor G. A. Amicis has just published (Bull. Soc. Geol. Ital., 1893) "I foraminiferi del pliocene inferiore di Trinité-Victor (Nizzardo)," an important contribution to our knowledge of the Pliocene Foraminifera of Italy. One hundred and twenty-six forms are recorded, to each of which a very full and interesting synonymy is given, while only two forms are recorded as new, an evidence of the extreme care bestowed upon his work by the author, who has swept away many varietal forms recently described as new by other authors from imperfect acquaintance with the literature. (Nat. Sci., Feb., 1894.)

In summing up the data concerning the drainage features of the upper Ohio Basin, Messrs. Chamberlain and Leverett agree that the evidence is very strong that the two uppermost sections of the Allegheny basin, (including also Oil Creek Basin) and the middle Allegheny discharged northwesterly; the evidence relative to the lower Allegheny and the upper setion of the Ohio River favors a northerly discharge, but is too incomplete to justify a firm opinion. The authors hold to the belief that no hypothesis of continuity can explain the phenomena of the glacial drift and terraces of the region under discussion. They offer four hypotheses in explanation of the phenomena observed, all of which agree on the most vital points, and all emphasize the importance and significance of the first glacial epoch. (Am. Journ. Sci., Vol. XLVII, 1894).

MINERALOGY AND PETROGRAPY.[1]

Eleolite Rocks from Trans-Pecos Texas.—In a recent report on Trans-Pecos Texas Osann[2] gives a few brief notes on the igneous rocks of the region. The most interesting points in the article, which, on account of the short time allowed the author to prepare it, is little more than a collection of notes, refer to the alteration of limestones by granite and the production of a rock composed almost exclusively of calcium silicates; to the existence of eleolite syenites and phonolites in the Davis Mountains; to the occurrence of a tourmaline schist in the Van Horn Mountains, and of altered diabases and squeezed porphyries in the Carriso Mountains. The eleolite syenite is a fine grained, light colored rock with the typical trachytic structure. It contains orthoclase, eleolite and olivine as phenocrysts and sodalite, aegyrite, malacolite, hornblende, arfvedsonite and the rare minerals ainigmatite, laavenite and pyrrhite in its groundmass. The olivine is nearly colorless in thin section. It usually plays the part of a nucleus around which the other dark components have crystallized. The pyroxene occurs in two generations. The amphiboles are also in two generations, and often these and the pyroxenes are intergrown with their *c* axes and clinopinacoids coinciding. Ainigmatite is common in the rock, laavenite and pyrrhite are rare. The phonolites fall into two types. Those of the first type are characterized by their fine grain, by the abundance of needles and grains of aegyrite in their groundmass, and the absence from them of amphibole and other accessory components. In the rocks of the second type are a few phenocrysts of feldspar and of nepheline, the latter of which are often bordered by a dark corona of bisilicates. The most prominent of these are aegyrite and malacolite among the pyroxenes and among the amphiboles a variety with a strong pleochroism as follows: A=dark greenish blue; B=dark grayish brown; C=light yellowish brown. Cutting the eleolite syenite are dykes of tinguaite, monchiquite, alnoite, ouachitite, and a rock to which the author gives the name paisanite, since it was found in Paisano Pass in the Davis Mountains. This new rock consists of a few phenocrysts of quartz and of sanidine in a dense white matrix spotted with blue hornblende whose optical properties show it to be riebeckite. The white matrix is composed of

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2]Fourth Ann. Rep. Geol. Survey of Texas, p. 123.

intergrowths of albite and orthoclase cemented by granophyric quartz. It is unfortunate that the author cannot further pursue the studies so auspiciously begun.

The Differentiation of Rock Magmas.—In a recent number of the *Journal of Geology* are two contributions relating to the theory of the differentiation of rock magmas. One, by Iddings,[3] is a simple statement of the nature of the phenomena that have led to the proposal of the theory. The article does not discuss the causes of the differentiation of magmas except in general terms, but it deals with the facts that seem to indicate that such a differentiation of a homogeneous magma into unlike parts is alone capable of accounting for the great differences observed in the various rocks emanating from a single volcanic center, and in different portions of the same rock mass. The second article, by Backtsröm[4], was written to call attention to the difficuly of explaining magmatic differentiation upon Soret's principle, which applies, so far as we know, only to dilute solutions, and effects only the proportions existing between the solvent and the dissolved body in different portions of a solution. The author prefers to consider rock magmas as mixtures of liquids, some of which are less soluble in others at certain temperatures than at certain different temperatures. Hence if a homogeneous magma cools to a temperature when some of its constituents become difficultly soluble in the mixture of the others, it will become separated into parts possessing different compositions—liquation will ensue. Thus basic concretions are sometimes formed in acid rocks, and the acid and the basic lavas of Iceland occur in numerous flows, side by side, while intermediate rocks are absent.

The Old Volcanics of South Mountain, Pennsylvania.—Miss Bascom[5] has examined with great thoroughness the acid volcanics of South Mountain, Pa., whose existence was made known to the geological public a year[6] ago, and has described briefly the results of her study. These volcanics exhibit many of the features of modern rhyolites in spite of the fact that they have undergone profound alteration since their eruption. Fluidal, micropoicilitic, spherulitic, axiolitic and lithophysal structures are noticed in the various speci-

[3]Jour. Geol., Vol. I, p. 833.
[4]Ib., Vol. I, p. 773.
[5]Jour. Geol., Vol. I, p. 813.
[6]Amer. Jour. Sci., XLIV, p. 482.

mens; perlitic parting is occasionally detected in them; amygdaloidal phases are not uncommon, while taxitic and trichytic structures are frequently met with. The original components of many of the South Mountain rocks have entirely disappeared and in their place are now found only quartz, epidote, magnetite and leucoxene. These minerals are evidently secondary and yet in some specimens they are associated in micropoicilitic intergrowths, thus indicating to the author the secondary origin of this structure in the present instance. The spherelites in the rocks under consideration are often imbedded in a base that was formerly a glass, though it is now a holocrystalline quartz–feldspar mosaic, which must necessarily be of the nature of a devitrification substance, since the mosaic is crossed by delicate perlitic partings. The rocks of the region are thus comparable with the lava flows of more recent age. Some of them were obsidian, others were lithoidal rhyolites and others holocrystalline rhyolites. The structure of the obsidians is now microcrystalline in consequence of the alteration or devitrification processes to which they have been subjected. They are now felsites or microgranites, but their microgranitic structure is not original. It is the result of devitrification. The author would therefor not call the rock a microgranite, nor an obsidian, but would designate it as an apobsidian or an aporhyolite, indicating that it was once an obsidian which has become devitrified—the preposition signifying that the rock to which it is prefixed has undergone alteration of a specific nature.

Another Occurrence of Websterite.—Another occurrence of the basic rock websterite is reported by Harker[7] from Fobello, Lombardy, Italy. The rock is a dark aggregate of black diallage moulding smaller grains of hypersthene. In thin section the diallage is colorless. An eclogite from Port Tana, Norway, consists of garnets holding inclusions of cyanite, omphacite and zircon, imbedded in a groundmass composed chiefly of colorless omphacite and quartz, in which lie phenocrysts of idiomorphic enstatite. A garnet amphibolite from Sutherland, England, a quartz diorite from Viti Leon, Figi, and a uralitized gabbro from Ena, Tonga Islands, are also described by the same author.

Petrographical News.—The nickel ores of Sudbury, Ontario, like those of Norway and Sweden, are associated with gabbro and norite, along their contact with other rocks. The ores are supposed by

[7]Geol. Magazine, VIII, 1891, p. 1.

Vogt[8] to be cencentrations from the magma that yielded the gabbro since the olivine of this rock often contains small percentages of nickel and other comparatively rare metals. The principal ore is a nickel marcasite with 3—5.5 per cent. Ni. The same author describes a nickeliferous pyrite from Beiern, Norway, whose density is 4.6, crystallization regular and hardness 4. It is not magnetic.

A peculiar quartz-porphyry consisting of quartz phenocrysts and crystals of apatite and an altered mineral supposed to be enstatite imbedded in a very fine grained weakly doubly refracting groundmass, which is water clear in thin section except where bespattered with dust inclusions or amorphous iron oxide, is mentioned by Hornung[9] as probably forming a sheet among the diabases and clay slates near Stalberg in the Harz.

Since many of the Maryland granites enclose fragments of other rocks that have suffered contact metamorphism, and since their microscopic constituents possess the characteristics of substances that have solidified from fusion, while the rock masses are intrusive in other rocks Keyes[10] believes he is justified in regarding them all as eruptive in origin.

Piedmontite from a new American Locality.—The rhyolites[11] of the South Mountain region in Pennsylvania and Maryland are characterized by their pink or bright red color, which, according to Williams,[12] is due to the large quantity of *piedmontite* in them. This rare manganese epidote occurs as a constituent in the rock mass, as radiating fibres filling veins and as well terminated crystals enclosed in *scheelite* occupying cavities in the rock. The latter were well enough developed to afford material for optical study. The elongation of the crystals is parallel to b. Their pleochroism is A=yellow; B=amethyst; C=carmine. Optically they are identical with piedmontite from other localities. An analysis gave (after correcting for quartz):

SiO_2	Al_2O_3	Ce_2O_3	R_2O_3	Fe_2O_3	Mn_2O_3	MnO	CaO	MgO	K_2O	Na_2O	H_2O	CuO	PbO	Total
37.37	22.07	.89	1.52	4.78	8.15	2.28	18.83	.30	.81	.27	2.48	.13	.17	=100.05

a result indicating that the South Mountain mineral is intermediate in composition between allanite, true piedmontite and mangan-epidote.

[8]Norges Geol. Undersög., 1892.
[9]Min. u. Petrog. Mitth., XIII, p. 373.
[10]Bull. Geol. Soc. Amer., Vol. IV, p. 299.
[11]American Naturalist, March, 1893, p. 273.
[12]Amer. Jour. Sci., 1893, XLVI, p. 50.

The mineral, when in the groundmass of the rhyolite is often associated with a pale rose epidote (*withamite*) and the common green variety, the latter in some cases surrounding the piedmontite. All of the epidotes are supposed to be of secondary origin.

Some American Minerals.—The interesting mineral *rowlandite* from Llano Co., Texas, to which reference has already been made in these notes, has recently been described by Hidden and Hillebrand[13]. Its color varies from bottle green to a pale drab green shade. It is more vitreous than gadolinite, is transparent in thin splinters and it weathers to a waxy brick red substance. The mineral is isotropic. Its hardness is 6 and its density 4.515. An analysis gave:

SiO_2	X	ThO_2	Ce_2O_3	La_2O_3 etc.	Yt_2O_3 etc.	Fe_2O_3	FeO	MnO	CaO
26.04	.39	.59	5.06	9.34	47.70	.09	4.39	.67	.50
MgO	Alk	H_2O	CO_2	Fl	P_2O_5	Total—O=F			
1.62	.28	.24	.34	3.87	tr	= 101.12—1.63 = 99.99.			

Disregarding the CO_2 and CaO and reducing the rare earths to a hypothetical one with the molecular weight of the yttrium group the formula becomes $Si_4\ Yt_4\ Fe\ Fl_2O_{14}$ or $Fe\ (YtF)_2\ Yt_2\ (Si_2O_7)_2$.

Transparent *xenotine* in small crystals associated with muscovite in a quartz pocket is reported by Hidden[14] from near Sulphur Spring, Alexander Co., N. C., and a green variety of the same mineral from the Brindletown gold district, Burke Co., in the same State. The green xenotine has been found only in the gold gravels, forming the interior portions of some of the rough brown crystals intermingled with the sand. It is thought to be original substance from which the brown material was derived by weathering. An analysis of the green mineral indicates a complicated composition:

SiO_2	ZrO	UO_2	ThO_2	Al_2O_3	Fe_2O_3	$(La\ Di)_2O_3$	$(Yt\ Er)_2O_3$	CaO	P_2O_5	F	H_2O
3.46	1.95	4.13	tr	.77	.65	.93	56.81	.21	30.31	.06	.57

In a paper entitled "Minerological Notes" Moses[15] describes *pyrite* crystals from a cavity in limestone at King's Bridge, N. Y. The crystals are octahedral in habit, with the octahedral faces striated parallel to $\infty 0 \infty$ and $\infty 02$. On the diploid and pyritoid faces the striations are parallel to their intersections, while the cubic faces are unstri-

[13] Amer. Jour. Sci., XLVI, 1893, p. 208. Cf. also AMER. NAT., 1893, p. 248.
[14] Ib., XLVI, 1893, p. 254.
[15] Ib., XLV, 1893, p. 488.

ated. The same author[16] has analyzed *ettringite* from the Lucky Cuss Mine, Tombstone, Arizona. The mineral is in aggegrates of radiating fibres resembling in appearance a fibrous pectolite. These fibres are doubly refracting and have apparently a parallel extinction. The analysis of selected material gave:

SiO_2	Al_2O_3	CaO	SO_3	H_2O at 115°	Loss at red heat		Total
1.901	10.157	25.615	17.675	33.109	10.872	=	99.329

Reduced, these figures correspond with the formula

$$2\,[(H_{\frac{14}{5}}\,Ca\,Al_2)\,O_3]_2\,SO_3+8\,H_2O.$$

Pentlandite occurs at the Sudbury Mine in Ontario, intergrown with massive pyrrhotite. Penfield finds[17] its density to be about 5, and its composition: S = 33.42; Fe = 30.25; Ni = 34.23; Co = .85; gangue = .67. This corresponds to (Fe Ni) S, in which Fe : Ni = 1:1.32. The three supposed new sulphides *folgerite*, *blueite* and *whartonite* described by Emmens from this locality are thought by Penfield to be nickeliferous pyrite (blueite and whartonite) or mixtures of pentlandite with some impurity (folgerite).

Hidden reports[18] two new localities for gem *turquoise*. One is in the Cow Springs district of Grant Co., N. M., fifteen miles south of the Azure Mining Company's claim in the Burro Mountains, and the other is 150 miles east of the Burros in the Jarilla Mountains, Doña Ana Co., in the same State. Both localities were formerly worked by the natives. The matrix of the mineral in both cases is a trachyte traversed by fissures filled with quartz, limonite, kaolin, jarosite and other minerals. The kaolin is the result of alteration of the trachyte and the turquoise is regarded as a further alteration product of the kaolin.

A list of the minerals known to occur in Michigan is given by Hubbard.[19] Among these is a talc which the author calls *beaconite*. It occurs in fibres like those of asbestus, with an index of refraction = 1.5–1.6, an optical angle 2V = 60°, and a density of 2.74–2.88 Their composition as found by Packard is:

[16] Cf. also Zeits. f. Kryst., XXII, p. 16.

[17] Ib., XLV, 1893, p. 493.

[18] Ib., XLVI, 1893, p. 400.

[19] Rep. State (Mich.) Board of Geol. Survey, Lansing, 1893, p. 171.

SiO_2	Fe_2O_3 . FeO	MnO	MgO	Ign	Total
59.72	8.67	.64	26.42	4.13	= 99.58

corresponding to $H_2\ (Mg\ Fe)_3\ (SiO_4)_3$.

A pink vitreous *zoisite* found at the Flat Rock Mine, Mitchell Co., N. C., associated with monazite and allanite, has been analyzed by Eakins.[20] Its composition is:

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	H_2O	Total
38.98	31.02	4.15	.23	23.80	2.03	= 100.21

Specimens of *cacoxenite* from six localities have been examined optically by Luquer[21]. All the crystals show parallel extinction, and a few of the larger ones appear pleochroic in orange and light yellow tints. From a few measurements the approximate axial ratio 1: .75 was calculated.

The *heulandite*[22] from McDowell's quarry, Upper Montclair, N. J., crystallizes in forms agreeing essentially with those of crystals from Baltimore.

The material of the pale green crystals of muscovite from the dolomite of King's Bridge, N. Y., is a mica of the first order. Its apparent axial angle is 2E = 62° 11′, 2E = 60° 37′.

Mineral Syntheses.—The ferrous bye-products of aniline factories at Laar, near Ruhort, Westphalia, when dumped upon the ground to dry, are so rapidly oxidized that the heaps soon become too hot to handle. The material hardens and assumes a metallic lustre.[23] On the walls of cavities within it crystals form whose habit is that of *hematite* but whose composition indicates an admixture of hematite with magnetite.

Upon heating to 1200° in a graphite crucible for several hours, one part of titanic iron and two and a half parts of pyrite, Michel[24] obtained a crystalline mass with the properties of *pyrrhotite*. This is filled with vacuoles on whose walls are implanted tiny crystals of *rutile* with the characteristics of the natural mineral.

Monticellite in well developed acicular crystals is reported by von

[20] Amer. Jour. Sci., 1893, XLVI, p. 154.
[21] Ib., 1893, XLVI, p. 154.
[22] A, J. Moses: School of Mines Quart., XIV, p. 326,
[23] Zeits. d. deutsch. geol. Ges., XLV, p. 63.
[24] Bull. Soc. Franc. d. Min., XVI, p. 37.

Gümbel[25] as existing in the slowly cooled silicate slags from the lead furnace at Friehung near Vilseck in Bavaria.

V. Goldschmidt[26] calls attention to the advantage of glass over charcoal in securing sublimates of volatile substances arising during blowpipe analysis. He also gives the description of an apparatus which enables the manipulator to reduce his metallic compounds upon charcoal and collect their sublimates upon ordinary object glasses.

[25]Zeits. f. Kryst., XXII, p. 269.
[26]Zeits. f. Kryst., XXI, p. 329.

ZOOLOGY.

Classification of the Nemertines.—There has been a disinclination on the part of some systematists to adopt the subdivisions—Palaeonemertini, Schizonemertini, Hoplonemertini and Malacobdellini proposed by Hubrecht. Dr. Otto Bürger has returned to the problem, and he proposes[1] the following divisions:

Protonemertini in which the longitudinal nerve cord lies either in the ectoderm or between this and the muscular layer; Mesonemertini in which the cords are in the muscular layer, and Metanemertini in which they are found in the body parenchyma. Bürger further calls attention to "lateral organs" in many species of Carinella. They consist of epithelial discs, sometimes projecting sometimes grooved, richly supplied with nerves, and, although sometimes containing glands, always free from pigment. He halfway expects that some Nemertine will be found in which the whole lateral line is made up of such sense organs.

Ceratodus.—At last we are to have an adequate monograph of this most interesting form. Some years ago the Royal Society of London gave a grant to ascertain its history. An English naturalist was sent to Australia, where he obtained considerable material for an account of this and the Monotremes, but this material has been treated in a regular dog-in-the-manger fashion. Some two or three years ago, aided by funds from the Ritter foundation, Dr. Richard Semon went to Australia with the same object in view, and the results are now beginning to appear.[2] From the first parts we learn that Ceratodus is confined to the middle portions of the Burnett and Mary rivers; that it cannot go upon land, and that it may be caught with a hook baited with almost any animal substance. The native name is given as Djelleh (we had supposed it to be Barramunda). It breathes between 30 and 40 times a minute. The reproductive season lasts from April to the last of November, and is at its height in September and October. The eggs are enveloped in a gelatinous envelope, and their specific gravity is greater than that of water. The segmentation is much like that of Petromyzon and the Amphibia. The development within the egg occupies 10 to 12 days, and the anterior extremities appear 14 days after hatching, the hinder after 2½ months. No fold was observed connecting the anterior

[1] Verh. Deutsch. Zoolog. Gesellsch. III Jahresversammlung, 1894, p. 24.

[2] Deuksch. Med. Nat. Ges. Jena. Bd. iv, 1894, also separate.

and posterior limbs. There are no larval gills nor sucking mouth. Young fish are rarely taken, and those under a foot in length, never.

Some Proposed Changes in the Nomenclature of the American Mammalia.—The changes in nomenclature herein proposed are the outcome of a critical study of the literature and synonymy relating to the Mammals of Ord's Zoology, which was published in Philadelphia in 1815, in the second American edition of Guthrie's Geography.

As already announced in THE NATURALIST (March, 1894, p. 289), a reprint of a recently discovered copy of this extinct work will be shortly issued by the subscriber. In an appendix to this reprint the following emendations are fully discussed. For several of these no claim of originality is pretended, as they only reaffirm the decisions of others which have not hitherto met with general acceptance, but which, after a very careful examination, appear to merit the endorsement of scientists. The Code of the American Ornithologists Union has been made the basis of these determinations.

1. Red, or New York Bat, *Atalapha borealis* (Müller), "Der Neujorker," Natursys. Suppl., 1776 (No. 21) p. 21, antedates *Atalapha noveboracensis* Erxl., Syst., Reg. Anim., 1777, p. 155.

2. Hence "*Vespertilio borealis*" Nilsson, Illum. Fig. Scand. Fauna haft, 1838, p. 19, pl. 36, being preoccupied, will have to stand as *Vesperugo nilssoni* Keys. & Blas., Wiegm. Archiv., 1839, p. 315.

3. Hang-lip Bat, *Noctilio labialis* (Turton), Syst. Nat., 1802, p. 25, antedates *Noctilo abliventer* Spix, Sim. et Vesp. Brasil, 1823, p. 58.

4. Nine-banded Armadillo, *Tatusia novemcincta* (Linnæus), Syst. Nat., 1758, p. 51. *Tatusia peba* Desmarest, Mam., 1820, p. 368, is a synonym.

5. Arctic Walrus *Rosmarus rosmarus* (Linnæus), Syst. Nat., 1776, p. 49. *Rosmarus trichechus* Gill, Johns. Univ. Cyclop., III, 1877, 633, is in violation of the Code. *Odobœnus* Linnæus (1735) not binominal, was not legally used by Malmgren (Ofver K. Vet. Akad. Forh., 1863, p. 130) until after *Rosmarus* of Scopoli (Introd. Hist. Nat., 1777, p. 490).

6. West Indian Manatee, *Trichechus manatus* Linnæus, Syst. Nat., 1758, p. 34. *Trichechus* is only applicable to the Manatee. Linnæus' type of the genus was the West Indian species. *Trichechus inunguis* (Natterer) is the eastern South American species, and *Trichechus senegalensis* (Desmarest), the Old World representative.

7. Northern Gray Wolf, *Canis lupus nubilus* Say, Long's Exp. R. Mts., I, 1823, 169.

Mexican Gray Wolf, *Canis lupus mexicanus* (Linnæus), Syst. Nat., 1766, p. 60.

If we consider the American Wolf a distinct species from the European, and the Mexican animal a subspecies, their names should stand *Canis mexicanus* Linnæus (sup cit.) and *Canis mexicanus nubilus* (Say.) (sup cit.). *Canis lupus griseo-albus* (Sabine) J. A. Allen, is inadmissible. *Canis lupus griseus* Sab. is antedated by *C. griseus* Boddaert, Elench. Anim., 1784, p. 97.

8. American Gray Fox, *Urocyon cinereoargenteus* (Müller), Natursys. Suppl., 1776, p. 29. Müller's name, as in the case (sup. cit.) of *Atalapha borealis*, has priority over Erxleben's *Urocyon virginianus*, Syst. Reg. Anim., 1777, p. 567.

9. American Red Fox, *Vulpes pensylvanicus* (Boddaert), Elench. Anim., 1784. p. 97.

As cited by Gray, Cat. Brit. Mus. Carniv., 1869, 205, this name has long priority over *Vulpes fulvus* (Desmarest), Mam., 1820, p. 203.

10. Canada Otter, *Lutra canadensis* (Schreber). The "*Mustela lutra canadensis*" of Schreber, Saugt., III, 1778, pp. 458, 588, pl. cxxvi, β, has priority over *Lutra canadensis* (Turton) Syst. Nat., 1802, p. 57, to whom this name has been accredited. "*Lutra hudsonica* Lacepede" is a reference I am unable to find.

11. *Ursus americanus cinnamomum* Aud. & Bach., N. Amer. Quad., III, 1853, p. 125, is a synonym of *Ursus horribilis* Ord, Guth. Geog., 1815, p. 291. Both are based on the "Brown" Grizzlies of Lewis and Clark, from the Missouri Valley. These bears should stand as *Ursus arctos horribilis* (Ord). The Pacific Coast Grizzly (if separable) should be named *Ursus arctos horriaeus* Baird, U. S. Mex. B'dry Sur., 1859, p. 24.

12. American Black Bear, *Ursus americanus* Pallas, Spic. Zool., 1780, pp. 6–24. This form, with its brown and yellow variants, is sufficiently constant to remain specifically separable from *arctos*. *Ursus luteolus* Griffith (vid Merriam, Proc. Biol. Soc. Washn., 1893, p. 147), if not distinct from it, is a well-defined variety of *americanus*. Its affinities with *arctos* are much more remote.

13. American Badger, *Taxidea taxus* (Schreber), Saugt., III, 1778, p. 520, pl. 142, β. *Taxus*, in a specific sense, has long been misapplied to the European Badger. Schreber originally gave it to the American species, and his name antedates *Taxidea americana* (Boddaert), Elench. Anim., I, 1784, p. 136. The European Badger will stand as *Meles meles* (Linnæus).

14. "Mexican Shrew, *Sorex mexicanus*" Turton,= Tucan, *Geomys mexicanus* (Turton), Syst. Nat., 1802, p. 72, antedates *Geomys mexicanus* (Lichtenstein), Abhan. K. Akad. Wiss. Berl., 1827, p. 113.

15. Florida Gopher, *Geomys tuza* (Ord), Guth. Geog., 1815, p. 292, has unmistakable right of priority over *Geomys pinetis* Rafinesque, Amer. Mon. Mag., 1817, p. 45.

16. Pennsylvania Meadow-Mouse, *Arvicola pennsylvanica* (Ord), Guth. Geog., 1815; p. 292 (foot-note), undoubtedly refers to same species named *A. riparius* by Ord in 1825. Rafinesque's *Mynomes pratensis*, Amer. Mon. Mag., II, 1817, p. 45, further necessitates retention of Ord's first name.

17. "Small Black Squirrel" (=Black Gray Squirrel), *Sciurus carolinensis pennsylvanicus* (Ord), Guth. Geog., 1815, p. 292.

Ord, in a foot-note, defines the Western Alleghanies of Pennsylvania as the type habitat of this race. As such it represents the *S. leucotis* of Gapper, Zool. Jour., V, 1830, 206, over which Ord's name has priority.

18. Eastern Red Squirrel, *Sciurus hudsonius* (Erxleben), Syst. Reg. Anim., 1777, 414, antedates *S. hudsonius* Pallas, Nov. Sp. Glir., 1778, 376. Credit for this name has been wrongly given to Pallas.

19. Hudson Bay Flying Squirrel, *Sciuropterus volucella sabrinus* (Shaw), Gen. Zool., II, 1801, p. 157. *Sciurus hudsonius* Gmelin, Syst. Nat. I, 1788, 153, can never stand for any *Sciuropterus*, owing to Gmelin's double use of it in the above citation.

20. Columbia Gray Squirrel, *Sciurus griseus* Ord, Guth. Geog., 1815, p. 292 (Mss. marg. note of author); ibid, Jour. de Phys., LXXXVII, 1818, 150, antedates *Sciurus fossor* Peale, Mam. U. S. Expl. Exp., 1848, p. 55. The Californian subspecies will stand *S. griseus nigripes* (Bryant).

21. Red-Breasted Squirrel, *Sciurus rubicatus* Ord (same references as above for *S. griseus*), antedates *Sciurus douglassi* Bachman, Proc. Zool. Soc., 1838, p. 99.

22. Mexican Deer, *Cariacus virginianus mexicanus* (Gmelin), Syst. Nat., 1788, p. 179, is based on the "Teuthlalmacame," Hernandez, Hist. Mex., 1651, pp. 324, 325. The description of the latter does not apply to the Prong-horned Antelope, *Antilocapra americana*, so asserted by Berlandier (Baird, Mam. N. Amer., 1857, p. 666; Alston, Biol. Cent. Amer., 1879, pp, 82, 113). Hernandez's figure of the Teuthlalmacame (p. 324), whether of the Deer or the Antelope (it partly fits both), cannot affect the description, which applies to the Deer, as also Pennant and Gmelin have construed it.

23. Black-faced Wood Brocket, *Cariacus tema* (Rafinesque), Amer. Mon. Mag. I, 1817, 44. Mr. Alston, Biol. Cent. Amer., 1879, p. 118, declares this animal to be the *Cariacus rufinus* Bourc. & Puch., Rev. et Mag. Zool., 1851, p. 561. Reference to the descriptions of Hernandez and Rafinesque confirms this view and seems to justify the retention of Rafinesque's specific name as above.

24. Mountain Sheep, *Ovis cervina* Desmarest, Nouv. Dict. Hist. Nat., 1818, p. 551. *Ovis montana* Cuvier is preoccupied by *Ovis montana* (Goat) Ord. "*Ovis montana* Geoff." is a myth. *Ovis canadensis* Shaw, Nat. Misc. XV, pl. 610, is undated.

25. American Bison, *Bison bison* (Linnæus), Syst. Nat., 1758, p. 72.

26. South American Tapir, *Tapirus terrestris* (Linnæus), Syst. Nat., 1758, p. 74.

—Samuel N. Rhoads.

Zoological News.—Worms.—J. P. Moore describes[3] four new species of Branchiobdella parasitic upon American crayfishes. These differ from all European species in the character of the vasa deferentia.

Louis Joubin has just published a monograph of the Nemertines of France, making an octavo volume of 235 pages, illustrated by four plates.

Rotifers.—H. S. Jennings points out[4] that the genus Plœosoma of Herrick (1885) has, as synonymes, the names Gomphogaster, Gastropus, Gastroschiza, Bipalpus and Dictyoderma. The species which Herrick described as *P. lenticulare* may be the same as *Euchlanis lynceus* Ehrenberg; if not, it is a distinct form. Jennings also states that *P. hudsoni*, of Europe, inhabits Lake St. Clair, as does *Hudsonella picta*.

Mollusca.—P. H. Mason, among other interesting facts states[5] that cases of mimicry and of hybridization are unknown among the shells of molluscs, and that these cannot be invoked as playing any part in the evolution of new forms. He would rather believe that the variations are to explained as depending upon the relations of the animal to the shell and of the whole to its surroundings.

[3]Proc. Acad. Nat. Sci., Philadelphia, 1893, 419.
[4]Zool. Anzeiger, xvii, p. 55, 1894.
[5] Jour. Conch., vii, 328.

Hexapoda.—F. W. Goding catalogues[6] with synonyms 278 species of North American Membracida. The new genera are Evashmeadea and Vanduzea.

Joamny Martin has investigated the place of oxygen in insects.[7] A solution containing indigo in a colorless condition, but capable of becoming blue in contact with oxygen, was injected into the body cavity of various larvæ, and subsequent dissection showed that only in the neighborhood of the finest tracheal branches, where the "spiral filament" is lacking, was the solution colored. Consequently it is only in these regions that oxygenation of the blood can occur.

Hemichorda.—In an article "Who First Found Balanoglosus?"[8] the Rev. A. M. Norman says that Cavolini figures it in the Atlas of Delle Chiaje. To this Carus replies[9] that in the text the figure is said to represent the spiral ovary [the urticating tentacles spirally coiled up] of "Rombo amento," according to Delle Chiaje *Stephanomia uvaria.* Norman replies[10] that Cavolini's figure refers to the "ovary of *Agalmopsis cavolinii.*"

[6] Bull. Illinois State Lab. N. Hist., xiv, p. 391.
[7] C. R. Soc. Philomath, Paris, 24 Dec., 1893.
[8] Ann. & Mag. N. H, xiii, 136, 1894.
[9] Zool. Anz., xvii. Liter. p. 10, 1894.
[10] L. c., xiii, p. 216, 1894.

EMBRYOLOGY.[1]

Oökinesis in Limax maximus.—The observations here given are confined to early stages of the egg while in the oviduct, and before the expulsion of either polar globule. The article, therefore, deals with stages which, for the most part, preceed any discussed by Dr. Mark in his excellent treatise on *L. campestris*.[2]

Of the following wood-cuts, Fig. 1 is a diagrammatic representation of the oviduct from a laying animal, from which eggs were taken, and studied serially as numbered. The vitellus averaged 156.2 μ in diameter.

FIG. 1.

Various methods were made use of in fixing—Fols solution: osmic acid, 1 %, followed by Merkel's fluid; chromic acid, $\frac{1}{3}$%, etc., but the one which gave the best satisfaction was as follows: The body cavity of a laying animal was opened by a quick cut of the scissors, and the animal plunged into a boiling hot solution of corrosive sublimate; allowed to remain one minute; transferred to water and eggs removed from oviduct and shelled.[3] Vitellus allowed to remain in distilled water two minutes, then transferred to 35 and 50 % alcohol, remaining three minutes in each grade; then to 70 % alcohol for permanent preservation. I found that if eggs were allowed to remain in distilled water three hours or more, they shelled better, the vitellus coming out clearer and freer. For examination of eggs in toto, Czokor's alum cochineal gave, as a rule, good results. Ten minutes' stay in this dye appeared to give the necessasy differentiation; but for examination of sections much longer time was necessary, two to three hours or more. Picrocarminate of lithium was also found to be excellent, if anything, better than Czokor, on account of its differentiating nucleus structures.

[1]Edited by E. A. Andrews, Baltimore Md., to whom communications may be addressed.

[2] "The Maturation, Fecundation and Segmentation of *Limax campestris* Binney," by E. L. Mark, Bulletin of the Museum of Comparative Anatomy, Vol. 6, parts 11 and 12, Cambridge, Mass, 1881.

[3] In the upper part of the glandular portion of the oviduct there were a number of eggs in which the outer membrane or shell was barely formed, in some, egg No. 1, for example, there was no membrane at all, and in others only the inner membranous coat was present.

For examination in toto, 24 hours in this stain, and then washing with distilled water and pure alcohol gave good results.

Section staining on slide was also found desirable and Safranin was the stain used—2½ hours, followed by acidulated (½ % Hcl) alcohol of 90 % grade for 7–10 minutes.

The Schällibaum should be new, the sections carefully applied to a well smeared slide, and kept at 60° C. for exactly 15 minutes.

If Mayer's albumen fixative is used, only warm, and as soon as paraffine is melted remove slide from heat.

A number of sections of the hermaphrodite duct (h. d. Fig. 1) were made. One egg was found, in this duct, near the hermaphrodite gland, containing two polar corpuscles, each surrounded with a faintly stained Hof, and each showing striae radiating from corpuscle through Hof. About 8 chromosomes were observed irregularly grouped in the well-defined archoplasm of Boveri.[4]

From these sections it appears that the centres of attraction which Garnault[5] says do not exist in the ovarian egg of *Arion* and *Helix*, and which were not seen in the hermaphrodite gland of *L. maximus*, do exist in the duct very near the gland. They evidently appear immediately after the egg has left the ovary. This duct was lined, for the most part, with ciliated epithelium, and contained much mucus.

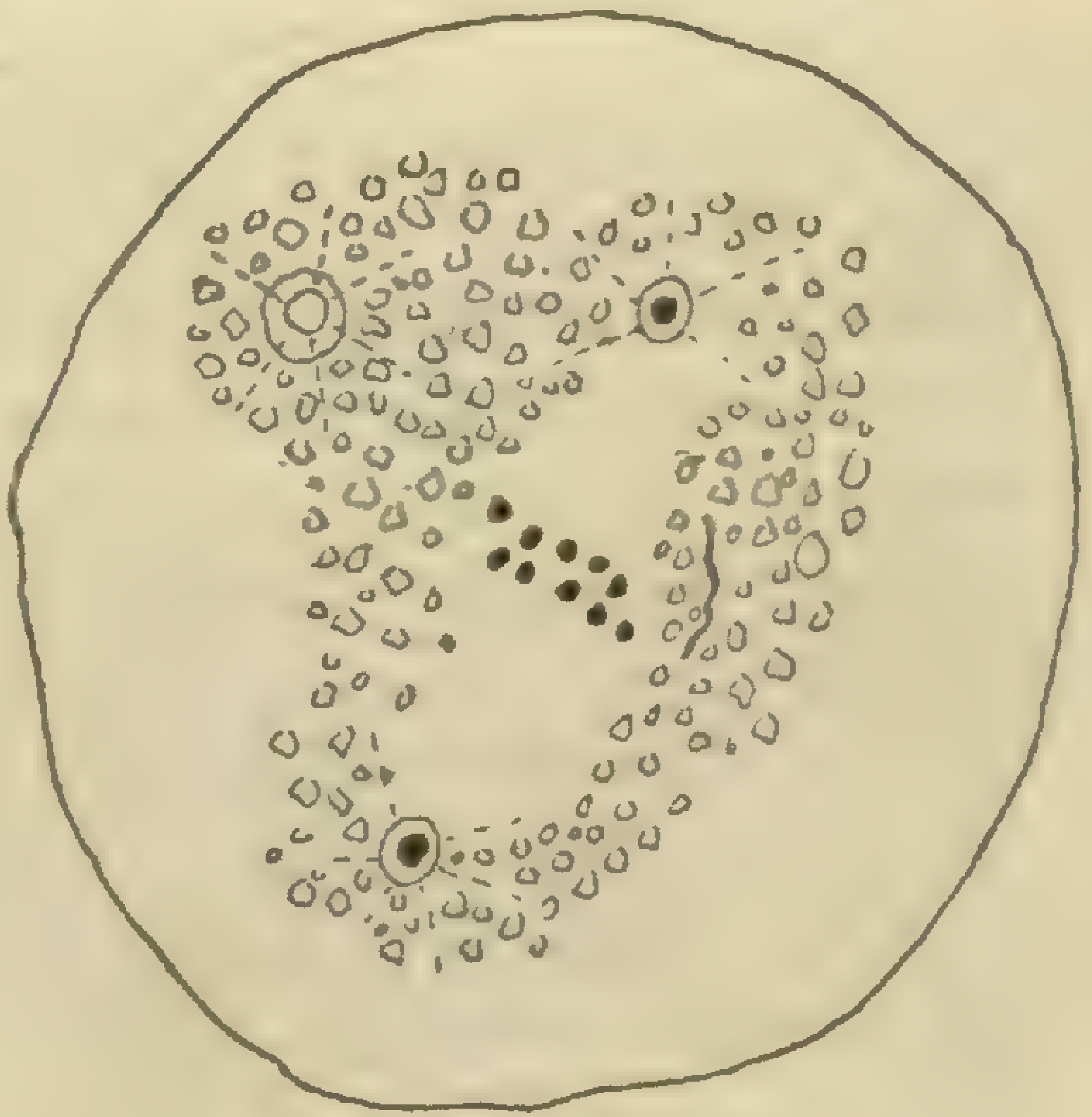

FIG. 2.

Fig. 2 illustrates an optical section of egg No. 1 from glandular part of the oviduct (see Fig. 1) viewed obliquely to the long axis of the spindle, and showing the two polar corpuscles and chromosomes, there being about twenty of the latter lying in an irregular cluster in the clear space between the corpuscles. This egg was stained in picrocarminate of lithium for 30 hours. In its examination a Zeiss Oc 2 and Obj. E were used. A broken membrane, "membrane rougée," was seen with apparently chromatic thickenings in it. Observations on this egg coincide closely with those of Garnault on *Arion* and *Helix*, and, in a measure, with those of Vejdovsky on *Rhynchelmis*.[6]

[4] "Zellen-Studen" von Dr. Theodor Boveri, Jena, 1887.

[5] "Sur les phénomēnes de la fécundation chez l' Helix aspersa et l' Arion empiricorum."—Zoöl. Anzeiger Nos. 297 and 298, Dec., '88 and Jan., '89.

[6] Die Entwecklungsgeschicete der Oligochaeten (*Rhynchelmis*), 1888.

The larger corpuscle is the one nearest the observer. The structural peculiarity of one side of the nucleus should be noted—where cytoplasm and yolk granules are in intimate relation with contents of nucleus. This is Garnault's "prophase;" it is the stage just previous to formation of nuclear plate leading to the forming of first polar globule. In another egg, No. 9, from the same oviduct, an optical section showed rays of hyalocytoplasm pushing out from clear area through granules of vitellus. Chromosomes irregularly placed in hyaline area. Spindle striae observed in viewing the egg at right angles to spindle axis.

Fig. 3.

Fig. 3 illustrates an optical section of egg No. 11 from oviduct of another animal, occupying the same relative position as No. 11 in the oviduct drawn. In an eccentric position, and near the surface, a clear circular area with radial striae was observed, indicating the presence of the male pronucleus. A portion of the membrane of the germinal vesicle still present. Egg No. 10, in the same animal, also showed circular male area in direction of axis of spindle, and chromatin granules within it. In egg No. 9 the head of spermatozoön was seen in optical section, some little distance from periphery, circular with narrow Hof about it and striae radiating from Hof. Very fine granules were evident within this pronucleus.

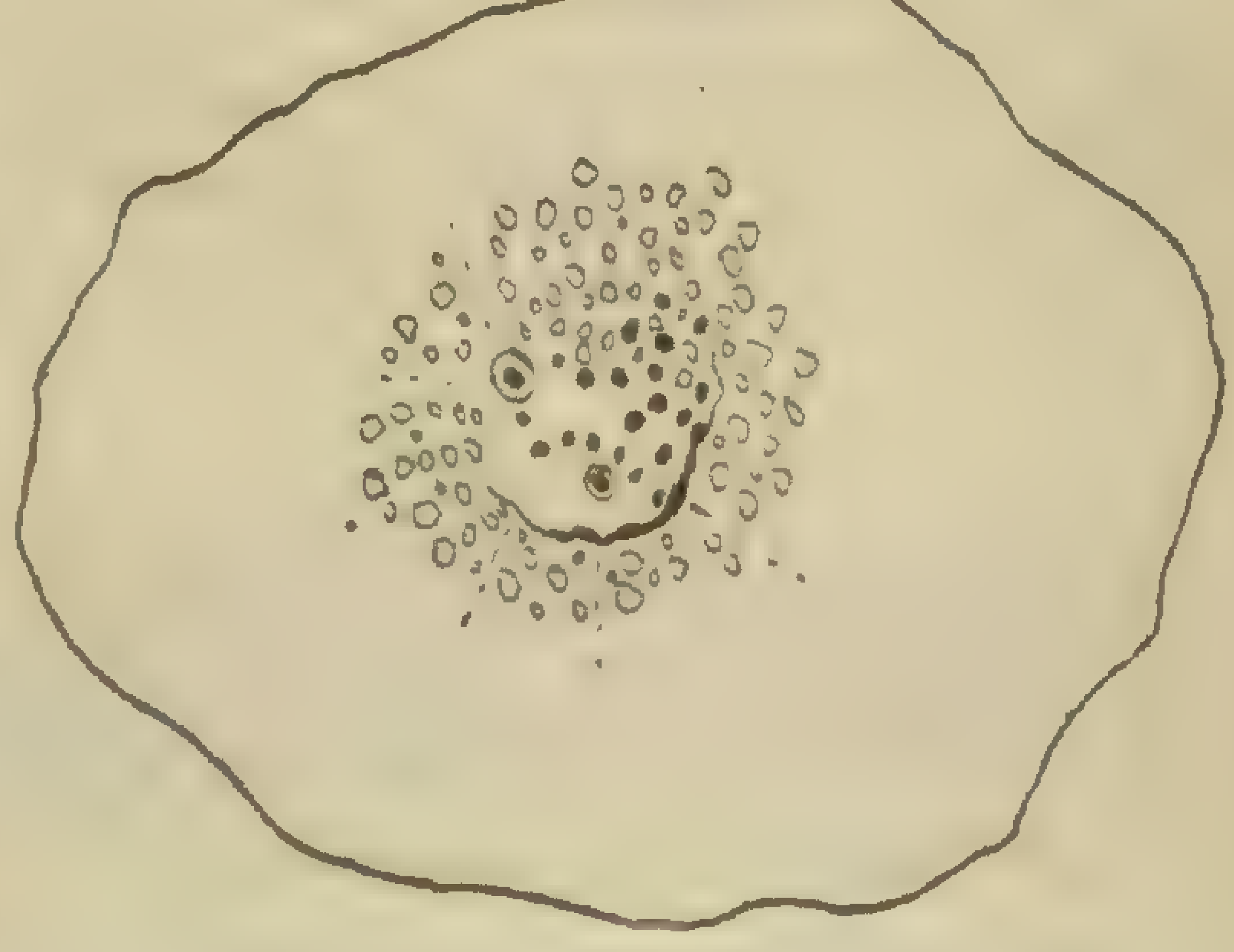

Fig. 4.

Fig. 4 illustrates part of a section of egg shown in Fig. 2, cut in such a plane as to show the sperm nucleus near the periphery. Drawn with Zeiss Oc 1 and $\frac{1}{18}$ oil immersion. Garnault says, in speaking of formation of sperm nucles in *Arion* and *Helix*, "the spermatozoön enters just before first kinesis or immediately after. The contracted head does not begin to change until after the expulsion of the second polar globule. The sperm-head first

divides into two chromatin spherules, then, by successive divisions, there is formed a great number of spherules which remain inclosed in a clear areole. This clear areole recalls the hyaline centre of attraction when that has received the half plate for the formation of a vesicular nucleus.[7]

—F. L. Washburn.

[7] The following few notes pertaining to the fixing and staining of *freshly laid* eggs may be of interest.

Eggs placed for 5 minutes in Fol 99 (1 % chromic 25 vol, 2 % acetic 50 vol, H_2O 25 vol) then shelled in water, vitellus in same solution for 5 minutes, H_2O 10 min., and 35 % and 50 % alcohol 5 minutes each, 70 % 30 min. and 90 % ad. lib. gave good results, taking picrocarminate of lithium very well if left long enough in stain. They also took borax carmine very well after the above treatment.

Both of these stains did well after the eggs were immersed in chromic ⅓ % 10 min., then shelled in large quantity of water, then vitellus in chromic ⅓ % 4 min., and H_2O and grades of alcohol as above.

Whole egg in osmic acid 1 % 5 min., followed by Merkel's fluid 4 hrs.; shell, then water and grades of alcohol 2 min. each to 70 % for permanent preservation were quite satisfactory. It gave good results as to nuclei when eggs were left in picrocarminate of lithium for 48 hrs.

ENTOMOLOGY.[1]

Tertiary Tipulidæ.—Another important contribution to our knowledge of fossil insects has just been made by Mr. S. H. Scudder, whose Tertiary Tipulidæ[2] is in many respects one of the most satisfactory memoirs upon a fossil family that we have. It is remarkable that a large proportion of the several hundred specimens of these delicate insects collected in the famous Florissant deposits have not only "the venation of the wings completely represented, with all their most delicate markings, but also the slender and fragile legs with their clothing of hair and spurs, and to some degree at least the antennæ and palpi. Even the facets of the compound eyes are often preserved as in life." The nine lithograph plates accompanying this paper show very well the correctness of these statements.

Mr. Scudder describes twenty-nine new species belonging to ten genera of Limnobinæ and twenty-two new species belonging to five genera of Tipulinæ. The general results of his study are summarized as follows:

1. The general facies of the Tipulid fauna of our western tertiaries is American, and agrees best with the fauna of about the same latitude in America, as far as we are at present acquainted with it.

2. All the species are extinct, and though the Gosuite Lake and the ancient lacustrine basin of Florissant were but little removed from each other, and the deposits of both are presumably of oligocene-age, not a single instance is known of the occurrence of the same species in the two basins. The Tipulid fauna of the Gosuite Lake, however, is as yet very little known, and it should be added that the few described species are in no instance the same at Green River, Wyo., and White River, Colo., both localities in the same ancient lake basin.

3. No species are identical with any of the few described European tertiary Tipulidæ.

4. Restricting ourselves to the Florissant basin, from the paucity of material in the Gosuite fauna, it will be noticed that a remarkable proportion of genera (eight out of fifteen) are not yet recognized among the living, these genera including about one-third of the species.

[1]Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2]Tertiary Tipulidæ, With Special Reference to those of Florissant, Colorado, By Samuel H. Scudder. Proc. Amer. Phil. Society, vol. XXXII. Reprinted April 4, 1894.

5. With one (American) exception—Cladura—all the exisiting genera which are represented in the American tertiaries are genera common to the north temperate zone of Europe and America, and are generally either confined to these regions or the vast proportion of their species are so confined. A similar climate is indicated, but this latter conclusion should be received with hesitation, since our knowledge of the distribution of American genera is mostly confined to the Atlantic States. There are, however, no certain indications of a warmer climate, such as have been shown from the study of other groups.

6. There are no extinct groups higher than genera, but one or two of these, such as Cyttaromyia and Micrapsis, are of a somewhat striking character.

7. The relative importance of the two subfamilies of Tipulidæ though differing on the two continents of Europe and America both in tertiary and in recent times, was much the same, on each continent, in tertiary times as now; while in the relative preponderance of the different tribes of Limnobinæ, our tertiary fauna shows a somewhat closer agreement with the European tertiary than with the existing American fauna. There are, however, no striking generic alliances pointing in the same direction.

Dr. Packard on Lagoa crispata.—In an important paper presented to the American Philosophical Society[3] Dr. A. S. Packard gives an interesting account of a remarkable moth, accompanied by seven plates of figures. The larva in question is remarkable because it possesses the rudiments of two pairs of abdominal legs in addition to the five pairs usually present in lepidopterous larvæ. In summing up the characters which lead him to consider Lagoa a generalized type the author says: In the superficial characters of the imago and in having in the larva abdominal legs, Lagoa resembles the Liparidæ, but in all its essential characters, those of the egg, larva, pupa and imago, it belongs with the Cochliopodidæ, except in the matter of the presence of abdominal legs in the larva. On this account it seems fairly entitled to be regarded as the type of an independent group. We may either regard it as a generalized ancient group of Cochliopodidæ, and refer it to a subfamily Lagoinæ, or we may boldly remove it altogether from either of the two families mentioned and consider the genus as the representative of a distinct family and designate the group by the name

[3] A Study of the Transformations and Anatomy of *Lagoa crispata*, a Bombycine Moth. Proc. Am. Phil. Soc., vol. XXXII, pp. 275–292.

of Lagoidæ. This on the whole seems to us to be the most judicious course to pursue. At all events the insect is plainly enough an ancient ancestral or generalized form. It is, so to speak, a primitive Cochliopodid with larval abdominal legs. It lays eggs like those of Limacodes, etc.; its head in the larval state is concealed from above by the prothoracic hood; its larval armature is more of the Cochliopodid type than Liparid; so are the pupal characters and the nature of the cocoon; and the shape of the important parts of the head and the essential features of the venation are overwhelmingly Cochliopodid. Under these circumstances we feel justified in regarding Lagoa as a most interesting ancestral form, and as affording arguments for considering the Bombyces, as a whole, as a generalized and ancestral group, and epitomizing the other higher Lepidopterous families somewhat as Marsupials do the placental orders of mammals."

In a note Dr. Packard announces his recent discovery that Lagoa is preoccupied by Megalopyge of Hübner, and Lagoidæ by Megalopygidæ of Berg.

Miss Ormerod's Report.—Miss Eleanor A. Ormerod's seventeenth report on the injurious insects of England which has lately appeared forms a volume of 152 pages treating of a great variety of insect pests. There are a number of illustrations, several being new. The most remarkable insect appearance of last season was the so-called plague of wasps, already mentioned in the NATURALIST. Concerning this Miss Ormerod writes: "The enormous excess of wasp presence over the average was in many places nothing short of a calamity, inflicting pain, and to some degree danger to ourselves, and to horses exposed to sudden attack, and great loss to fruit-growers. Within our houses in many cases the wasps swarmed to such a degree and especially at meal times as to make their presence on the food a real trouble; the agricultural or garden laborers were severely stung where working on crops to which the wasps had been attracted by the presence of aphides, or on fruit stocks where budding was going forward. Also pain, risk and delay in farm work were caused by fierce onslaughts of wasps from nests turned up in plowing. Great losses were caused by the quantity of fruit entirely ruined up to almost wholesale destruction in the grounds of large fruit growers, and to this must added the losses to shop owners dealing in such commodities as find favor in the eyes of wasps for their own consumption, or thievish abstraction for food of the coming on generation still in maggot condition, to be counted by hundreds, in each of the vast number of nests which were the headquarters of the marauding and troublesome pests."

Miss Ormerod attributes the extraordinary abundance of the wasps to the early and long continued drouth which enabled the insects to get an unusual start.

New York Reports.—The Eighth and Ninth Reports of Dr. J. A. Lintner, State Entomologist of New York, have recently been published. They are good sized volumes giving abundant evidence of the pains-taking preparation so characteristic of their predecessors in the same series. The contents of the eighth report include an introductory summary of the important entomological events of 1891; a discussion of a number of injurious insects; notes on various insects and remedies for them; two entomological addresses, and a bibliography of the publications of the entomologist for 1891, 1875 and 1876. The ninth report is equally full of varied and valuable information, and contains besides a reprint of Dr. Asa Fitch's Catalogue of Homoptera which will be ap-appreciated by many students.

Notes.—Mr. Alex. A. MacGillivray of Ithaca, New York, continues his papers on North American Thysanura in *The Canadian Entomologist.* He advises the restriction of the name Poduridæ to genera having the saltatory organ, and includes the genera in which it is absent under the Aphoruridæ. A number of new genera and species are described.

An interesting colored plate showing the variations of the larvæ of *Arctia caia* appears in *The Entomologists' Record,* Feb. 15, 1894.

Prof. T. D. A Cockerell publishes in Bulletin 10 of the New Mexico Experiment Station a List of Insects found on Cultivated plants in the Mesilla Valley.

Two new Deltoid moths—*Pseudaglossa forbesii* and *Pallachira hartii*—are described by Prof. G. H. French in a recent Bulletin of the Illinois State Laboratory of Natural History.

In a circular recently issued from the Department of Agriculture Mr. L. O. Howard announces the spread of *Aspidiotus perniciosus* through many eastern states, and gives directions for its destruction.

In Bulletins 35 and 36 of the West Virginia, Experiment Station Mr. A. D. Hopkins continues the publication of his studies of wood boring insects. A large number of fairly good original figures are published.

In Bulletin 51 of the Ohio Experiment Station, Mr. F. M. Webster publishes a number of miscellaneous articles. The one of most general interest is on "Some Insect Immigrants of Ohio."

Professor Herbert Osborn announces the discovery[4] that *Aphis rumicis* is the summer form of *A. euonymi*, and gives observations confirming the statement. He also reports upon the relations of the Schizoneura ovipositing on dogwood (Cornus) and the one living on grass roots.

[4] Bull. 23, Iowa Experiment Station.

PSYCHOLOGY.

The Recidivist.—In the September *Forum* there appeared an article on the topic "Criminals not the victim of Heredity." On summing up, the writer comes to the conclusion that "a criminal is like any other man." It is the purpose of the present writer to show, by unimpeachable and incontrovertible evidence, that this last statement is a gross error. The *Forum* writer makes an indiscriminate use of the terms professional, habitual, and congenital criminal. A professional criminal is not, necessarily, a congenital criminal, nor is an habitual criminal necessarily a professional criminal. I presume that the writer of the article quoted above, means the recidivist all through his paper, and therefore will endeavor to prove that the congenital criminal and the recidivist is, anatomically and physiologically, entirely different from normal man in many respects. In this paper I do not wish to enter the domain of speculative psychology, nor do I intend to grapple with the grave problems now agitating sociologists and penologists, therefore will content myself with the introduction of facts and facts alone. The statement of the present writer that the recidivist is, anatomically and physiologically, an abnormal type of man, is not the conclusion of an hour or day, but is the rational deduction obtained from days, months, and years spent at the dissecting table and microscope, and in the study of the criminal, both in a state of freedom and when incarcerated. The criminal physiognomy is of so marked a type that most men are able to recognize it at a glance. I borrowed six photographs of criminals from Major Owen, Chief of Detectives, Louisville, Ky., for the purpose of illustrating an article on "Criminal Anthropology," (which article appeared in the *N. Y. Medical Record*, Jan. 13), selecting them at random from some fifty or sixty other photographs of criminals. Five of these photographs were recidivists, and one was an *occasional* criminal. These six photographs were shown to one hundred men with the following statement and request: "Here are six criminals; five of them are habitual malefactors, and one of them is, comparatively speaking, an honest man—pick out the honest man." Ninety-five men picked out the photograph of the *occasional* criminal without a second's hesitation. The discriminating and exact Maudsley says: "All persons who have made criminals their study, recognize a distinct criminal class of beings, who herd together in our large cities in a thieves quarter, giving themselves up

to intemperance, rioting in debauchery, without regard to marriage ties or the bars of consanguinity, and *propagating* a criminal population of degenerate beings. For it is furthermore a matter of observation that this criminal class constitutes a *degenerate or morbid variety of mankind*, marked by peculiar low physical and mental characteristics. * * * * * * * Their *family likeness* betrays them as fellows by the hand of nature marked, quoted, and signed to do a deed of shame."[1] For obvious reasons, I have taken the liberty of italicizing certain words in the above quotation. A celebrated criminal lawyer of New York once told the writer that he could tell a recidivist at a glance, and that he never made a mistake in his diagnosis of moral obliquity. Professor Enrico Ferri, an Italian anthropologist, tells us that on one occasion he examined several hundred soldiers, and found only one whose face declared him a criminal. He afterwards ascertained that this man had committed murder. Lombroso submitted to thirty-two young girls the photographs of twenty thieves and twenty moral men. Eighty per cent. of these girls recognized the first as malefactors, the second as moral, upright men.[2] Emile Gautier, who was, for a time, confined in Lyons prison says that "these criminals have a general family resemblance, which makes them a class apart."[3] A warden of an eastern penetentiary (Sing-Sing) told the writer that there were not only twins in every prison, but there were "twins, triplets, quadruplets, ay! even twelvelets" (sic). An interesting point in connection with the criminal physiognomy is that it is to a large extent independent of nationality. The German criminal is not unlike the Italian, nor is the French unlike the English criminal. M. Joly remarks, 'I should say that in M. A. Bertillon's' office I was shown nearly sixty photographs of Irish, English, and American thieves. It would have been difficult in many cases to discern the Anglo-Saxon rather than any other physiognomy.[4]

Now let us analyze the criminal type, feature by feature, and see what constitutes this universal and well-marked physiognomy. The observations of the writer when in pursuit of this analysis, were not confined to any particular class of criminals; he examined all classes. He soon discovered, however, that this distinctive type was to be found in the congenital recidivist alone. The occasional criminal and the criminal by calculation (the true professional criminal), were found to

[1]Maudsley. Responsibility in Mental Disease, p. 29.
[2]Lombroso: L'Uomo Delinquente.
[3]Havelock Ellis: The Criminal.
[4]Havelock Ellis: The Criminal, p. 82

be anatomically and physiologically normal. In the recidivist there is marked exaggeration of the cephalic indices. In a dolichocephalic recidivist the long head is very noticeable. The same exaggeration is found in brachycephalic recidivists. Oxycephalism (sugar-loaf head) is very frequently observed. In three hundred drawings taken from live and dead subjects by the writer, one hundred and ninety-eight are oxycephalic. Lauvergne says of this kind of head: "When it is complete, that is to say, when it presents a prominent base supporting an inclined pyramid, more or less truncated, this head announces the monstrous alliance of the most eminent faculty of man, genius, with the most pronounced impulses to rape, murder, and theft." The bilateral elevation of the sagittal suture (Benedikt's lines[5]) has been noticed in the three of the six hundred, who form the class from which these deductions are drawn. Professor Benedikt considers these sutural elevations of great importance in criminal anthropology and in his book *Kraniometrie und Kephalometrie* says "that, though rare, when present they are significant of great moral obliquity." There is, generally, marked enlargement in the orbital arches of recidivists, together with receding foreheads. In three hundred and fifty of the four hundred profile and quarter-face photographs of habitual criminals that I have examined, this enlargement of the orbital arches was plainly noticeable. In the two hundred drawings and photographs that form my collection, it is noticeable in one hundred and eighty-two. Tenchini and Lombroso, as well as Benedikt, have pointed out this abnormality in the orbital arches of criminals. In my collection of skulls there are four skulls of recidivists; all of these show this enlargement of the orbital arches. Prognathism is a marked characteristic in the physiognomy of the recidivist. The large, heavy lower jaw and protruding mouth strikes the observer at once. This feature is rarely absent in the congenital criminal. It is an abnormality eloquent in its atavistic suggestiveness.

The low receding forehead, the enlarged orbital arches, the prognathous jaws, and high cheek-bones of the congenital criminal are strikingly like those of our pithecoid ancestors.[6]

Just here it is proper to state, that, in an article on Effemination and Viraginity which appeared in the *N. Y. Medical Record*, September 16th, I have asserted that atavism only attacks individuals of a neurasthenic type; that the phenomenon of reversion is found only in psychopathic aberrants. This, in a measure, is true in all cases of

[5]Benedikt: Kraniometrie u. Kephalometrie.

[6]The writer: Criminal Anthropology, N. Y. Med. Record, Jan. 13.

reversion, but, in the article alluded to, I then had reference to psycho-sexual atavism alone. Sexual perversion and psychic hermaphroditism are prominent characteristics of the congenital criminal; I do not intend, however, to discuss them in this paper. I have examined, macroscopically and microscopically, twenty-three criminal brains. Twenty of these brains were those of recidivists, and abnormalities were found in all of them. In one of them, taken from a criminal executed for an attempt at rape and murder, there was confluency of the fissures. In several of them the frontal lobe presented four (apparent) convolutions; in all of them there was deficiency in weight. In others the gray matter was scanty and thin, and the convolutions superficical and few in number. Havelock Ellis says: "The important matter of the vascular supply of the brain in criminals has yet received little attention, but a variety of pathological features have been found in the cerebral substance and membrance—pigmentation, degenerating capillaries, etc."; he then adds in conclusion, "It must be added, as a point of considerable importance, that in very few cases have these pathological lesions *produced any traceable symptoms during life*."[7] There are two kinds of abnormal ears found in the criminal type; large out-standing ears, like those of the chimpanzee and nshiego-mbouve, and ears, small, and closely applied to the skull, like those of the gorilla. I have found that the small ear is generally possessed by the sneak-thief and pick-pocket, while the large ear is possessed by the burglar with murderous tendencies. In all my experience I have never seen an habitual petty thief with a large ear, while all the murderers whom I have examined had large ears. A prison-keeper said to be on one occasion: "I can tell a thief from a murderer every time, by the size and shape of his ears." (sic). I have thirty-six sketches of pick-pockets. These drawings were made from life, and are drawn to scale, and in all of them the ear is small and, generally, misshapen. One sketch, made of a convict now in an Indiana prison, shows the strange abnormality of a forked helix. Féré and Segelas present a cut of an ear somewhat like the sketch just mentioned. There are other abnormalities in the ear of the recidivist, such as "a development of the Darwinian tubercle, absence of one of the branches of the fork, absence of the helix, effacement of the anti-helix, etc., etc."[8] Most of these abnormalities are, unquestionably, atavistic attempts, and especially is this true of the small gorilla-like ear and the large, projecting chimpanzee-like ear.

[7]Havelock Ellis: The Criminal, p. 63.
[8]Ibid, p. 68.

The criminal has a peculiar, feral stare, which once seen and noted can never be forgotten. A noted detective, (Bligh of Louisville, now dead) called it the "ape-eye."[9] "Look," said he to me on one occasion when we were discussing criminals, "Look at the next ape you see and you will know what I mean." (sic). The congenital criminal,[10] when looking at one seems to focus his sight on a point some distance beyond one's body. It is difficult to describe this look. Bligh's "ape-eye" comes nearer to it than anything else I can think of.

The special senses are generally very much exaggerated in the congenital criminal. The hearing of twenty-eight recidivists out of thirty tested with the watch, was found to be more acute than normal. Some of these criminals possessed the microscopic eyesight of birds, describing the appearance of minute objects correctly, the details of which, to be seen by me, rendered the use of a lens absolutely necessary; and I may add that my eyes are normal.

Others were far-sighted, some of them being able to read Snellen's type at double the normal distance. The sense of smell, that is for some odors, was decidedly more acute than normal. I washed my hands in water scented with a few drops of violet perfume; they were then washed in pure water and carefully dried. Three billiard balls were then held in the hands for a few moments and then deposited on a table with a half dozen others. Thirteen out of the twenty-eight recidivists under observation, picked out the balls which had been handled declaring that they could plainly distinguish the violet odor. * * * * * I once knew a recidivist in St. Louis who could tell his friends by their personal odors.[11] I had this man's skull in my cabinet for a number of years; it was eventually stolen from me, and is now, probably, in some museum of anatomy. It was strikingly like the skull of the Man of Spy,[12] and an extraordinary instance of atavism in every structural characteristic. I have now analyzed the physiognomy of the congenital criminal feature by feature. When I place each part in its proper place I construct a mosaic of a variety in the human race entirely different from normal man. I have shown

[9]The writer: Criminal Anthropology, N. Y. Medical Record, Jan. 13.

[10]I wish to call attention to the fact that I consider the congenital criminal to be the only true recidivist. I make this distinction in order to emphasize the great difference that exists between the professional, occasional criminal, and the true recidivist who is born a criminal. J. W., Jr.

[11]The reader is respectfully referred to the works of Spencer, Tylor, Reclus, Wolfe and others for kindred observations on the special senses of savages.

[12]Wright: Man in the Glacial Period, p. 277.

that these abnormalities are anatomically and physiologically irregular. The brain, the seat of the moral function is involved as well as bone, nerve and tissue. I have said nothing of color (pallor) of the hair, of cutaneous insensibility, of the form and shape of the extremities, and of numerous other abnormalities. I think that I have proven that the recidivist is *not* "like every other man." I promised in the beginning of this paper that I would not enter the domain of metaphysics. I have, in another article, fully discussed this branch of the subject. I cannot refrain, however, from noticing several of the *Forum* writer's statements. His whole paper is made up of assertions, the basis of which are founded on personal beliefs. It is the old story of religion against science; the old mistake of separating mind and brain matter, when, in a measure, the two are identical. I am not an Averroist, nor am I a believer in the doctrines of emanation and absorption. But I do believe, (and this belief can be proven to be correct), that wherever there are receptive ganglia, whether in organisms high or low in the scale of animal life, there this element of the brain, which the Greeks called Psyche, enters in. The *Forum* writer says that he does not believe that the moral function is an inherited one. Does he believe that man sprang into existence fully endowed with all the mental attributes we find in him at the present time? Does he deny the fact that mind has undergone evolution and development since the time of our pithecoid ancestors?. Does he mean to maintain that the brain of an infant born to-day is no further developed than was that of one born twenty thousand years ago? Would he have us believe that the moral function is no further developed in us than it was in the ancient Britons, or than it is in the autocthon of Australia? That morals are, to a certain extent, dependent on education, I do not for one instant deny, but that they are wholly so, no one, who knows the negro and the results of a hundred years of moral education expended on him, will for one instant affirm. I take the American negro simply because he is a convenient example. Morals are the result of evolutionary development, of inherited experiences, as much so as any other inherited function. The laws of atavism, of reversion to ancestral types, and of inheritance apply to the mind as well as the body. We cannot place morals, a purely mental function, on a pedestal by themselves and write beneath them "Cave! Deus Sum." Says the *Forum* writer: "The moment that he understands that 'honesty is the best policy' the average professional criminal becomes honest." As I have said before, in the first part of this paper, the *Forum* writer does not discriminate when speaking of criminals. Now this state-

ment may be true in the case of the professional criminal i. e. the criminal by calculation, but it is not true in the case of the recidivist. The recidivist never recognizes the fact that honesty is the best policy, but continues to commit anti-social acts until the end of his life. His moral imbecility, the direct result of atavistic degeneration, is such that he does not consider his anti-social acts criminal in any sense of the word. Dugdale in his remarkable work "The Jukes" has clearly proven how great a factor heredity is in the production of criminals. The evidence in his book alone ought to be convincing to any unbiased mind, but when it is substantiated by the evidence of such men as Lombroso, Ottolenghi, Ellis, Marro and Segelas it becomes absolute authority.

JAS. WIER, JR., M. D.

MICROSCOPY.[1]

Marine Planarians.—In a paper now in press (Journ. Morph., Vol. IX, No. 2), Dr. Wheeler gives a few notes on methods he employed in the study of *Planocera inquilina*, a Polyclad found in the branchial chamber of Sycotypus.

The Biondi-Ehrlich stain proved to be very useful in making the rhabdites conspicuous.

Owing to the lack of pigment, the nervous system may be traced without difficulty, especially in young specimens. It agrees closely with Lang's description and figures of the nervous system of *Planocera Graffii*. Remarkably clear pictures of the beautiful plexus and its connection with the brain may be obtained by killing in hot corrosive sublimate, staining for 12 hours in Czokor's alum cochineal, and, after dehydrating, mounting in gum sandarac dissolved in absolute alcohol.

In a second paper, l. c., p. 178, devoted to a Triclad (*Syncœlidium pellucidum*) found in the gill-books of *Limulus*, the method of studying the nervous system is described thus:

The great transparency of *Syncœlidium* makes it a very favorable object for the study of the nervous system. The brain and main nerve trunks may be readily seen in the living animal, but this method is insufficient for a study of details. It is, however, only necessary to stain with alum cochineal, extract as much of the stain as possible with water, dehydrate and mount directly from absolute alcohol in gum sandarac to obtain a diagrammatically clear picture of all but the very finest details of the nervous system. The nerves stand out as white lines on a darker background.

Breeding Habits of the Three Triclads of Limulus.—*B. candida*, *B. propinqua* and *S. pellucidum* all deposit their egg-capsules on the gill-lamellæ of their host, *Limulus*. The first species seems to show no preference for a particular region of the gill-leaf, but scatters its egg-capsules over the whole surface. *B. propinqua* selects the basal, or proximal region of the leaf, while *Syncœlidium* prefers a small area near the edge and just lateral to a small marginal callosity which forms a brown line with the callosities of the adjacent leaves when the gill-book is closed.

The egg-capsule of *Syncœlidium* is about .75 mm. long, of an oblong shape and somewhat compressed. It is attached by a slender pedicel, .5 mm. in length, in such a way that one of the flattened sides of the capsule is applied to the surface of the gill-leaf. Usually the capsules

[1]Ed. by C. O. Whitman, Univ. of Chicago.

are arranged with their long axes parallel to one another in a little cluster near the marginal callosity. The chitinous wall of the capsule is thin and transparent, but grows thicker towards the poles. Through it the two opaque white eggs or larvæ may be distinctly seen. I have never found more than two eggs in a capsule.

Many of the capsules bear at their outer ends one or more of the deep blue thecæ of an infusorium. These were regarded by Gissler as pneumatic tubes, but Ryder showed that they were the thecæ of "Protozoa of the genus *Epistylis* or *Zoothamnion*."

Both Ryder and Gissler figure the egg-capsules of *Syncœlidium* After describing the capsules of *Bdelloura*, Ryder says: "The second form, represented in Figs. 5–7, enlarged 16 times, is much smaller, but similar in structural features to the preceding. The capsules measure about $\frac{1}{25}$ of an inch in length and contain usually 2 eggs or embryos. At first the ova occupy each one of the ends of the capsule, as shown in Fig. 5; but after the young worms have developed somewhat, they usually lie alongside of each other lengthwise of the capsule. They frequently change positions, however, at this stage and it sometimes happens that there is but one embryo in a capsule."

Gissler's Fig. 2^b is evidently the capsule of *Syncœlidium*, as shown by its size relatively to the infusorial thecæ attached to its summit.

For a description of the egg-capsule of *B. candida* I would refer the reader to the papers of Leidy ('51), v. Graff ('79), Ryder ('82a) and Gissler ('82).

What I take to be the egg-capsule of *B. propinqua*, is considerably smaller than that of the allied *B. candida*, measuring only 1.25 mm. It appears to contain only one ovum, instead of 2–7 as in *B. candida*, but on this point I cannot be positive. I am unable to identify this form of capsule with any of those described by Ryder ('82a).

The three *Limulus*-infesting Triclads differ also in their time of breeding. *B. candida* oviposits during May and early June, when the *Limuli* return from the deep water to the sandy beaches to breed. The passage of the Triclads from one crab to another must be favored by the prolonged coitus of the latter. *Syncœlidium* oviposits in the latter part of July and the early part of August, when the gills are deserted by the half-grown young of *B. candida* for the basal joints of the cephalothoracic appendages. As the *Limuli* have laid their eggs and begin to return to deep water by the first days of July, it is necessary, in order to study *Syncœlidium* and its habits, to collect a number of the crabs early in the season and to confine them in a large fish-box or similar receptacle. *B. propinqua* appears to breed at the same time as *Syncœlidium*.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences.—Biological Section.— April 9. H. F. Osborn, in " A division of the Eutherian Mammals into the Mesoplocentalia and Cenoplacentalia ", noted that the radiation of the mesozoic placentals into carnivorous, herbivorous and insectivorous types, was analogous to that of recent placentals, or to that of Australian marsupials; Mesoplacentalia would represent a group primitive, as in foot and brain, of great evolutional inertia; it would include Amblypoda and Condylarthra as ungulate types, the Creodonta, Tillodonta and Insectivora as Unginculates and the Lemuroidea as primates.

O. S. Strong, exhibited "Nerve-cell Structures as demonstrated by Golgimethods", and presented for publication a memoir on the "Origin and Peripheral Distribution of the Cranial nerves of Amphibians."

P. Gibier, " A note on Glycosuria produced Experimentally."

A. B. Matthews, " On the Structure and Physiology of the Pancreas Cell." Bashford Dean, *Recording Secretary.*

Proceedings of the Natural Science Association of Staten Island.—April 14th, 1894 Mr. Chas. W. Leng exhibited living and mounted specimens of beetles, new to or rare on the Island, with the following memoranda:

BRYAXIS ABDOMINALIS (AUBE).

Three years ago I found a number of small beetles clinging to the underside of pieces of bark and wood lying on the banks of a salt meadow creek near Arlington; the beetles were first observed by me at the point where the railroad embankment ends and the trestle begins, but Mr. Davis had previously found the same or a closely allied species at other points on the border of the salt meadow. These beetles proved to be *Bryaxis abdominalis*, one of the Pselaphidæ, an addition to the fauna of Staten Island, and, in view of the numbers in which they were found and the rarity of the species of this family as a rule, an addition of unusual interest.

During the early spring of 1893 and again this year I have made some careful observations to determine the date of appearance and the exact localities frequently by those beetles. They may be found early

in February and as late as May, but disappear entirely in the summer months. During this brief period the eggs that are to produce the succeeding generation are laid and their life work being ended the beetles die.

To determine the localities I examined the border of the salt meadow at various points, usually accompanied by Mr. Davis. South of Oakwood a narrow peninsula of upland juts out into the meadow and there, on March 18th, the beetles were plentiful; the slight rise of ground was littered with boards, logs and fragments of bark, carried far inland by unusual tides, and almost every piece sheltered a *Bryaxis*. They did not extend more than ten feet from the meadow and they avoided those boards which were within a few feet of the meadow and constantly damp. On March 25th we searched the border of the meadow west of Richmond. The tides reach these meadows only by way of the Fresh Kills and the wreckage is sparse, perhaps becoming stranded before it reached so far inland. No *Bryaxis* were found. On April 1st I visited the strip of sandy upland that stretches into the meadow south of the water company's wells at New Springville. The conditions existing near Oakwood are here repeated and *Bryaxis* was found in some numbers. On the same day I crossed the turnpike and visited the meadows east of Chelsea, but there is an absence of any sharp dividing line between meadow and upland at that point; no suitable shelter is formed and no *Bryaxis* were found. On April 8th Mr. Davis, Mr. Walter Granger and I examined the meadows at Watchogue very thoroughly but found no large number of beetles. The day was, however, unfavorable and may have affected the result. During this period Mr. Davis twice visited the original locality at the trestle and found the beetles in numbers. This locality is particularly favorable; the operations of the railroad company have caused a quantity of soil to be thrown up in hillocks and ridges which afford the necessary retreat from high water and at the same time a lodging place for the chips and bark that shelter the beetles.

As the result of these observations, repeated in different years and at widely separated localities, I think I am justified in stating that *Bryaxis abdominalis* is abundant from February to May at the border of the salt meadow all around Staten Island; living not on the meadow or near enough to feel the influence of its dampness, but under wood or bark cast by the tide upon the upland.

These beetles are quite small and Mr. Craig kindly prepared a specimen for exhibition under the microscope.

The form of the antennæ, the single tarsal claw and the sculptured abdomen of the male are the characters specially noteworthy.

The family to which this beetle belongs comprises a goodly number of minute beetles, found either beneath stones or wood or in ants' nests. Their habits are but little known; they live on animal substances and their powerful mandibles and long palpal members seem to indicate that they capture fleet and hard shelled prey; some live in pairs while others are gregarious; those living in ants' nests appear to be true inquilines; the ants which support them, by caressing the tufts of hair about the abdomen, cause the exudation of a fluid which they greedily swallow. The larvæ are unknown.

An excellent monograph, by Brendel and Wickham, may be found in the Bull. Laborat. Nat. Hist., State Univ., Iowa, Vol. 1 and 2.

It may be noted that two other minute beetles are always found with this *Bryaxis*, viz: *Scydmœnus salinator*, Lec. and *Rhypobius marinus*, Lec. They are not confined to such narrow limits as the *Bryaxis* but invariably occur where it occurs.

Mr. Leng also contributed the following: *Notes on Naias Flexilis.*

The water plant, *Naias flexilis* (Willd.), Rost. and Schmidt, reported by Mr. Davis at our last meeting, occurs also at Springville and at Bull's Head.

At Springville sparingly, in a small pool on the edge of the meadow, south of Union avenue in the second large field west of the Morning Star road.

At Bull's Head abundantly, in a ditch running south from Lambert's Lane and about a quarter of a mile west of the Morning Star road.

Mr. Arthur Hollick presented a set of three barred owl's (*Syrnium nebulosum*) eggs and read the following memorandum:

In our Proceedings for April 11th, 1891, may be found a short note in regard to a barred owl's nest having been found by Mr. Chas. Rufus Harte, in the vicinity of Bull's Head, on March 27th of that year. On March 12th, 1892, it was again visited by Mr. Harte, as noted in the Proceedings for April 9th, 1892. On each occasion he obtained a set of three eggs from the nest. So far as I am aware the owls were not disturbed in 1893.

I had obtained a rough diagram of the vicinity, sketched by Mr. Harte, and on March 11th, of this year, I undertook to search for the nest. With comparatively little trouble I located the tree, which is situated in the patch of woodland between Bull's Head and Willow Brook. The cavity in which the nest is located faces northwest and is about thirty feet from the ground. The tree is about five feet in

diameter, and destitute of branches below the cavity, so that I found it impossible to climb up. On March 17th I obtained a pair of climbing irons, and with these readily ascended to the nest, which I found to contain the usual number of three eggs, slightly incubated.

The tree is not one which would be likely to attract attention, as it is a vigorous living red oak (not a sweet gum as originally stated), and the cavity is not conspicuous. The female bird was readily alarmed—a slight tap on the tree being sufficient to cause her to leave the nest and to retire to some distance. I did not see the male bird at any time.

In this patch of woods gray squirrels are yet comparatively abundant and one or more pairs of red shouldered hawks nest there every year, besides many crows, but it is doubtful if they can remain undisturbed much longer, as the timber is large and valuable and in several sections the finest trees have been thinned out quite recently.

Mr. Wm. T. Davis exhibited a living pupa and mud cone of the seventeen year locust, with the following memorandum:

The pupæ of the seventeen year *Cicada* have made their appearance. While searching for *Bryaxis*, with Messrs. Leng and Granger, on April 8th, I found several under boards on the edge of the meadow at Old Place creek, one of which I am able to exhibit alive. The ground being damp the pupæ had erected their usual towers of earth, the boards not lying sufficiently close to the uneven ground to prevent their construction.

In the Proceedings for February 10th, 1894, the *Cicadas* that appeared in 1881 should have been referred to Brood XVII instead of XVIII.

Boston Society of Natural History, April 18.—The following papers were read. Mr. Herbert Lyon Jones: Adaptations of fruits and seeds for the purpose of distribution. Dr. Benjamin Lincoln Robinson: Observations upon tropical climbers. Samuel Henshaw, *Secretary.*

SCIENTIFIC NEWS.

The University of Illinois is to open a permanent station on the Illinois River for the biological study of the flora and fauna of the waters of the state. Havana has been selected as the location and suitable laboratory quarters have been obtained. Work will be begun in April and the station will be kept open throughout the year. The Illinois State Laboratory of Natural History and the State Fish Commission will co-operate and the whole will be under the direction of Professor S. A. Forbes. Professor Forbes has selected in the vicinity of Havana a set of typical situations which will be explored throughout the year and probably for several years in succession. The main object is the thorough investigation of the entire system of the plant and animal life of the waters of that region with principal reference to problems of œcology; above all to the effect of the periodical overflow and recession of the waters upon the variety, abundance and interaction generally of the various groups of plants and animals represented in those waters.

Some students may have the Leitz's Mechanical Stage. The following directions copied from the American Edition of Leitz's catalogue of Microscopes and Accessories published by Richards & Co. of New York *may* enable them to apply the apparatus to their stands. "The screw on the right must be lost so, that the lever, of the form of an arc of a bow, can turn around the axis at which it is fixed on the left. Afterward, the stage is to be put on the stage of the microscope so, that both angle pieces, opposite to the lever, drives the column of the stand; after putting the lever to its place, the screw gets fastened again. At last, the stage, must be fixed to the column, by drawing close the other screw, being in the middle part of the lever."

Dr. Edmund Beecher Wilson has been elected Professor of Zoology in Columbia College. He was previously adjunct professor of biology.

Dr. L. Will, well-known for his studies in Hexapod morphology, has been called to the chair of Zoology in the University of Rostock.

Dr. F. Ulrich, Professor of Mineralogy and Geology in the technical school at Hannover, died Jan. 25, 1894.

Dr. C. V. Riley has tendered his resignation as U. S. Entomologist, to take effect June 1, 1894. After that date his address will be U. S. National Museum, Washington, D. C.

Dr. Alexander Theodor von Middendorff, possibly best known for his Siberian expedition, died at Hellmorm, Livonia January 28, 1894 aged 79 years.

Dr. Credner, who had been announced as the successor of Prof. H. B. Geinitz in the chair of Geology in the Dresden Technical school, will remain in Leipzig. The place will be filled by Prof. E. Kalkowsky of Jena.

The botanist O. L. Sillén of Gefle, Sweden, is dead.

Dr. Leopold von Schrenck, well-known for his explorations of the Amur basin, died in St. Petersburg, Jan. 20, 1894.

Dr. G. Linck, formerly docent, has been made Professor of Geology and Mineralogy in the University of Strassburg.

Dr. George Gordon, well-known to older naturalists. died in Edinborough, Dec. 12, 1893, aged 92 years.

Prof. Edward Zacharias of Strassburg has been called to Hamburg as director of the Botanical Gardens.

Dr. A. Knop., Professor of Mineralogy ln the technical school at Karlsruhe, died Dec. 27, 1893. Dr. R. Brauns of Marburg has been appointed extraordinarius in his place.

Richard Spruce, the student of South American Mosses, died at Malton, England, Dec. 30, 1893.

Dr. W. Migula has been called as Professor of Botany and Bacteriology to the technical school of Carlsruhe.

The trustees of the " Elizabeth Thompson Science Fund " have issued their circular for 1894 announcing that the income from the fund, now amounting to $26,000 will be available for distribution in June next. Already nearly $9000 have been distributed in past years to 46 applicants, and in 22 cases the results of work advanced by the fund have been published. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance." The Secretary

of the trustees is Dr. C. S. Minot, Harvard Medical School, Boston, Mass.

Dr. Carl Grobben has been raised to the ordinary professorship of Zoology in the University of Vienna.

Dr. George Bennett, an Australian explorer and Naturalist, died at Sydney in October, 1893, aged 90 years.

Mr. August Carl Eduard Baldamus, the ornithologist, died in Wolfenbüttel, Oct. 31, 1893, aged 82.

Juan Vilanova y Piera, Professor of Geology in Madrid, died in the beginning of November.

C. von Gumpenberg, a student of the Lepidoptera, died in Bamburg, Germany, Nov. 5, 1893.

A. Halfar, Geologist of the Prussian Geological Survey, died in Berlin, Nov. 21, 1893.

Prof. Joseph Boehm, the well-known plant-physiologist, died in Vienna, December 2, 1893.

Dr. Tomquist has been made private docent in Geology and Palæontology in the University of Vienna.

Professor Arcangeli Scacchi, the student of Vesuvius, died in Napha, Oct. 11, 1893.

Dr. J. M. Undset, the investigator of prehistoric Scandinavia, died in Christiania, Dec. 3, 1893, aged 40 years.

George Primics, geologist, died in Belénges, Hungary, Nov., 1893.

H. J. Rink, whose work on Greenland is the handbook upon all Arctic questions, died in Christiania, Dec. 15, 1893.

Dr. Luigi Luciani has been called to the chair of Physiology at the University of Rome as successor to Moleschott.

Prof. W. Krause of Göttingen has been given charge of the collections of the I. Anatomical Institute at Berlin.

Prof. R. Altmann of Leipzig, has been called to the chair of Anatomy in Halle.

Dr. A. Heider, the Bacterologist, died in Vienna, Dec. 26, 1893.

Professor August Wrzesniowski, well-known for his Protozoan studies, died in Warsaw, December last.

The Wollaston medal of the Geological Society of London, has been given to Prof. K. A. Zittel, the Palæontologist of Munich.

The Proposed Division of the National Academy of Sciences.—The following letter explains itself. To the Committee appointed by the U. S. National Academy of Sciences, April, 1892, "to report such proposed modifications of the Constitution and By-Laws of the Academy as are likely in their judgment to increase its efficiency" etc., of which Prof. T. C. Mendenhall is chairman;

Gentlemen: I take the liberty of making some suggestions with reference to the classification of the Academy into divisions, which will in the writer's estimation "increase its efficiency" etc. This increase of efficiency is, in the writer's view, chiefly to be accomplished at present, by electing to membership persons competent in their professions, in such proportionate numbers as to represent properly those professions, as at present cultivated in the United States. At present the disproportion of membership in favor of some departments, and to the prejudice of other departments is great, as the following figures show. Of members which represent the physical sciences, we have now, according to the figures presented at the late meeting, (April, 1894), by your committee, 58; while but 31 represent the Natural Sciences. If the members which represent the proposed section F be added to the division of Natural Sciences, (which they should not be in a correct classification) the latter will include 39 members as compared with 58.

The Academy adopted, at its late meeting of April, 1894, two classes, I and II, those of the Physical and Natural Sciences. The former includes the proposed sections A, B, and C, of the committees original plan; and the latter the proposed classes D, E, and F, of that plan. This primary division appears to me to be more convenient in practice than a closer subdivision, for the reason that a nearly equal division of membership between those two classes accords more nearly with the relative numbers of cultivators of those sciences in this country and in the world generally, than any other divisions that can be proposed. As a matter of fact the cultivators of the Natural Sciences are more numerous than those of the Physical Sciences, as the relative extent of the literature of the two divisions indicates. I do not suggest that this preponderance of the Natural Sciences shall be represented in the National Academy, but that there shall be an equality of representation of the two. In a closer subdivision the relative numbers of members of each division is more likely to be variable, or for various reasons more difficult to ascertain, and thus more likely to cause dissatisfaction from time to time.

The division into the two classes of the Physical and Natural Sciences does not, however, embrace all the sciences, and is hence defective. It does not take into account applied science, which it is necessary that we recognize, owing to our connection with the government. While we necessarily embrace members competent in this great field, we cannot open our doors to a large representation of it, since pure science is our principal aim. As most human industries are more or less perfectly applied science, we must necessarily strictly limit our membership in this direction.

The sciences which you have proposed to include in the class F, are Statistics, Hygiene, Philology and perhaps others. To these might be added the science of mind objectively studied, or Psychology, and also that of human industries treated historically and descriptively. This entire group (excepting Hygiene, which is applied science), differs from those of the Natural and Physical Sciences in that its subjects are penetrated and affected by the interference of the human mind.

I would therefore, propose the following division of the Academy's membership into four classes, two of which have been already adopted.

Class I.—Physical Science; (Sciences of energy); to include Physics, Astronomy, Chemistry, Physiology, and Dynamical and Chemical Geology.

Class II.—Natural Science; (Sciences of Morphology); Structural Geology, Mineralogy (apart from Chemistry) Biology (including Embryology and Paleontology).

Class III.—Anthropological Science (Sciences treating of phenomena determined by psychic conditions); Anthropology, Statistics, Philology, Psychology.

Class IV.—Applied Science. (Applications in the Arts of any of the Sciences previously enumerated); including Hygiene, Engineering, etc.

It will be observed that in the above classification geology is divided. This is inevitable, as the science is a composite one. Members might in this case choose whether they would prefer as geologists to be referred to Class I or Class II.

I would suggest that the members of each class be fixed as follows:

Class I, 35 members; Class II, 35 members; Class III, 15 members Class IV, 15 members; total 100 members.

It seems to me that both comprehensiveness and simplicity may be claimed for the above proposition.

Very respectfully,

Philadelphia, April 21st, 1894. E. D. Cope.

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Synonymic Catalogue of Diurnal Lepidoptera with Supplement, pp. VIII, 883 (1871–1877). £1. 9. 6.

The Supplement, separately, pp. VIII, 691–883 (1877), 8s. 6d.

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